Archives of Neurology and Psychiatry

VOLUME 57 APRIL 1947 NUMBER 4

CEREBRAL ANOXIA FROM HIGH ALTITUDE ASPHYXIATION

A Clinicopathologic Study of Two Fatal Cases with Unusually Long Survival and a Clinical Report of a Nonfatal Case

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EXPERIENCES during World War II have made it evident that aviators who collapse as the result of sudden and severe deprivation of oxygen while flying at high altitudes generally die within a few minutes or hours or recover completely. In a series of 181 cases of anoxic anoxia occurring in aviators, Burchell [1] and Burchell and Masland [2] reported 42 deaths and 139 survivals. Of the fatalities, the majority occurred at altitudes of over 24,000 feet (7,200 meters); in 2 of these cases the period of deprivation of oxygen was less than five minutes and in 20 from five to ten minutes. The men who recovered without subsequent ill effects were unconscious for periods varying in 7 instances from thirty to one hundred and fifty minutes at altitudes of between 27,000 and 28,000 feet (8,200 and 8,400 meters). Ward and Olson [3] related the case of an aviator who, owing to a depletion of his oxygen supply was without supplemental oxygen at altitudes between 28,000 and 20,000 feet (8,200 and 6,000 meters) for thirty-nine minutes and at altitudes between 20,000 and 12,000 feet (6,000 and 3,300 meters) for an additional sixteen minutes; he was unconscious for eight hours and semiconscious for twelve more hours and yet recovered completely. He was last examined about seven weeks after the accident. The absence of neurologic residua following deprivation of oxygen to the point of unconsciousness has been recorded also by Wormley,[4] Horvath, Dill and Corwin,[5] and von Tavel.[6]

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1. Burchell, H. B.: Report of Accidents from Anoxia in Aircraft, Air Surgeon's Bull. (no. 3) **1**:20 (Sept.) 1944.

2. Burchell, H. B., and Masland, R. L.: Vital Statistics: Anoxia, Air Surgeon's Bull. (no. 4) **1**:5-7 (April) 1944.

3. Ward, R. L., and Olson, O. C.: Report of a Case of Severe Anoxic Anoxia with Recovery, J. Aviation Med. **14**:360-365 (Dec.) 1943.

4. Wormley, G. W.: An Anoxia Accident in Eighth Air Force, Air Surgeon's Bull. (no. 9) **1**:20-21 (Sept.) 1944.

(Footnotes continued on next page)

In rare instances anoxic anoxia may lead to severe mental and physical incapacitation. Such a case has been described by Church and Loeser.[7] It concerned a ball turret gunner whose oxygen supply was shot away at an estimated altitude of 22,000 feet (6,600 meters). He was removed from the turret about fourteen minutes later, when the plane had descended to 16,000 feet (4,800 meters). He was semiconscious for approximately two and one-half hours, and when seen in the hospital was maniacal and totally blind. During the next few days his vision was partially restored, and he regained some ability to speak and comprehend. Four weeks after the accident, psychometric tests (Shipley-Hartford and Binet-Simon) revealed a reduction in the mental age to 15½ years.

The data in the foregoing cases would seem to constitute evidence that susceptibility to anoxic anoxia varies considerably. According to McFarland[8] and Behnke and Willmon,[9] healthy men are able to tolerate a reduction of oxygen pressure of about one-third that at sea level, which corresponds to an atmosphere at approximately 12,000 feet (3,300 meters). At this altitude the blood has an oxygen saturation of 80 to 85 per cent. At 33,000 feet (10,000 meters) and higher, even pure oxygen does not suffice to sustain consciousness unless under sufficient pressure (Armstrong and Heim[10]). It is well known that tolerance to rarefied atmosphere may be increased through gradual adaptation, and even to such a degree that life may be maintained at 23,000 feet (6,900 meters) for ten days (Gemmill[11]).

This paper presents the cases of 3 aviators who were deprived of oxygen at high altitudes for varying lengths of time and who subsequently exhibited severe mental and physical incapacitation. In 2 cases the outcome was fatal, and in the third the patient was observed clinically for a period of three weeks. Seven other cases, in which relatively

5. Horvath, S. M.; Dill, D. B., and Corwin, W.: Effects on Man of Severe Oxygen Lack, Am. J. Physiol. **138**:659-668 (March) 1943.

6. von Tavel, F.: Die Auswirkungen des Sauerstoffmangels auf den menschlichen Organismus bei kurzfristigem Aufenthalt in grosser Höhe: Ein Beitrag zur Frage der Leistungsfähigkeit in Höhenflug, Helvet. physiol. et pharmacol. acta, 1943, supp. 1, pp. 1-128.

7. Church, R. E., and Loeser, L. H.: Injury to Cerebral Cortex Following Anoxemia and Exsanguination: Report of Case, Bull. U. S. Army M. Dept., December 1944, no. 83, pp. 104-111.

8. McFarland, R. A.: The Internal Environment and Behavior: I. Introduction and the Rôle of Oxygen, Am. J. Psychiat. **97**:858-877 (Jan.) 1941.

9. Behnke, A. R., and Willmon, T. L.: Physiological Effects of High Altitude, U S. Nav. M. Bull. **39**:163-178 (April) 1941.

10. Armstrong, H. G., and Heim, J. W.: Medical Problems of High Altitude Flying, J. Lab. & Clin. Med. **26**:263-271 (Oct.) 1940.

11. Gemmill, C. L.: Acclimation to High Altitudes: Review of Physiological Observations, U. S. Nav. M. Bull. **39**:178-187 (April) 1941.

sudden death occurred as the result of exposure to an atmosphere at 20,000 to 30,000 feet (6,600 to 9,900 meters) were not included, inasmuch as the pathologic findings were of no moment. All these were studied at a United States Army general hospital in the Mediterranean Theater of Operations during the interval from December 1944 to May 1945.

MATERIAL AND METHODS

Blocks were taken from representative parts of the brain and from all the thoracic and abdominal viscera. They were fixed in solution of formaldehyde U. S. P. (1:4), embedded in paraffin and stained routinely with hematoxylin and eosin. Additional sections of the brain were stained with cresyl violet, and in certain instances for fat with scarlet red, for myelin by a modified Spielmeyer method and for axis-cylinders by the Bodian technic.

PRESENTATION OF CASES

CASE 1.—*Clinical History.*—A white sergeant aged 21 was admitted to the hospital Nov. 12, 1944. On that day he had gone on a mission over enemy territory. About five minutes after completion of a bomb run at an elevation of more than 20,000 feet (6,600 meters), he was found unconscious in the waist of the ship. The length of time he had been deprived of oxygen could not be determined. Artificial respiration with oxygen was instituted. During the flight back to the base he had a number of convulsions and on arrival was still unconscious.

On entrance to the hospital the patient was delirious. His temperature was 98.8 F., his pulse rate 88 and his respiratory rate 20. Cyanosis of the finger tips was observed. The pupils were dilated and fixed. The eyelids frequently twitched. The abdominal reflexes were absent. The lower extremities were spastic, and the Babinski sign was readily elicited bilaterally. During the course of the examination the patient had convulsive seizures.

Laboratory Data.—The hemoglobin was 14 Gm. per hundred cubic centimeters and the leukocyte count 29,000, of which 85 per cent were neutrophils. The urine was normal. Because of pronounced rigidity of the trunk, a spinal puncture could not be performed.

Treatment.—On entrance to the hospital the patient received a prophylactic inoculation of tetanus antitoxin, and, to combat the convulsive seizures, 15 grains (1 Gm.) of sodium amytal intravenously. Oxygen was administered continuously. As meningitis was suspected, he was given 25,000 units of penicillin sodium intramuscularly every three hours, and on two occasions 5 grains (0.32 Gm.) of sodium sulfadiazine intravenously.

Course.—Several hours after reaching the hospital, the patient's rectal temperature had risen to 102.2 F., the pulse rate to 110 and the respiratory rate to 38. Opisthotonos had increased. The pupils were constricted. Urinary incontinence became evident. On November 13 his general condition remained much the same. The temperature varied from 102 to 104.8 F., the pulse rate from 120 to 140 and the respiratory rate from 34 to 60. Generalized convulsive seizures recurred periodically. Episodes of profuse perspiration also were noted. On November 14 the patient's temperature had risen to 108 F., and his pulse became very rapid and weak. Death occurred approximately forty hours after the accident.

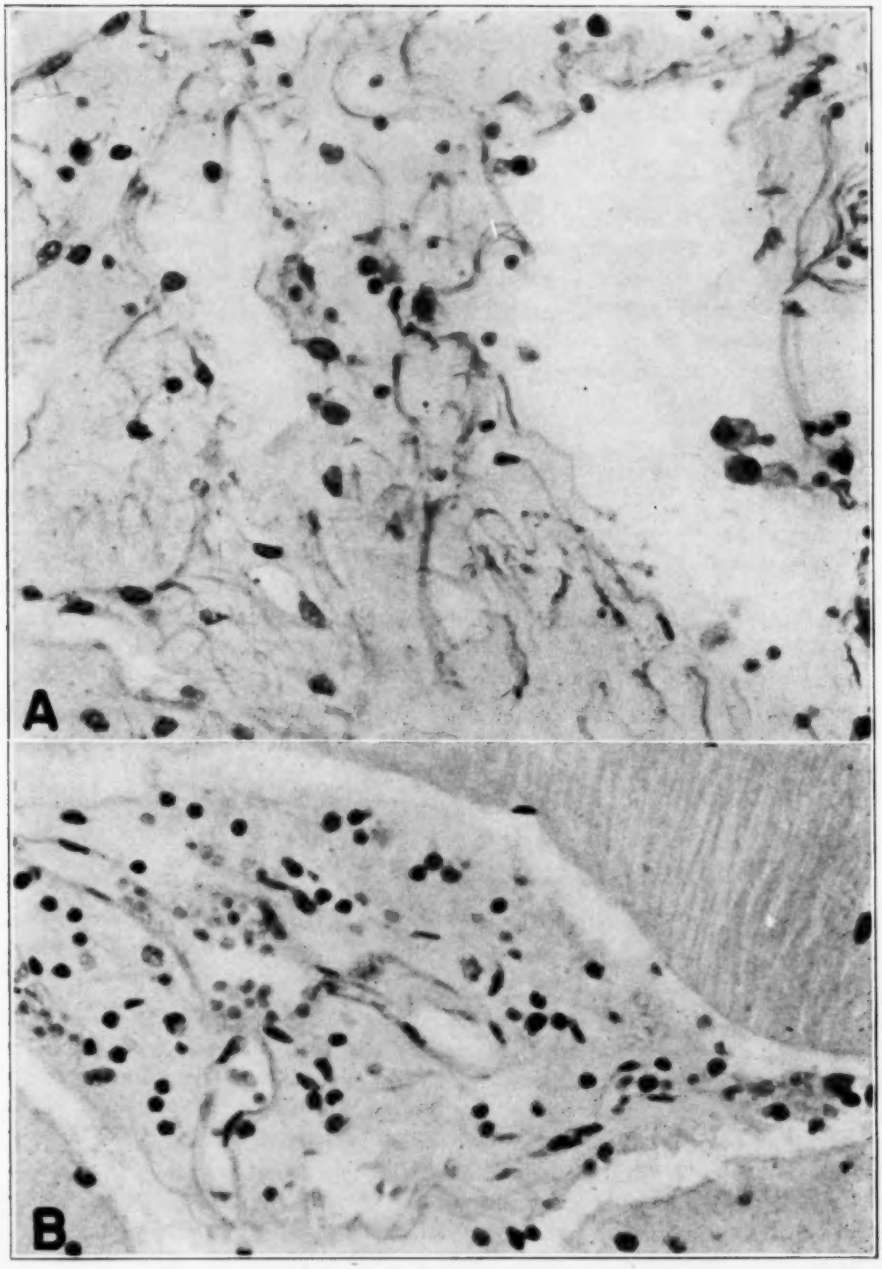

Fig. 1.—In *A* (AIP neg. 94296), from the leptomeninges of the cerebral cortex, there is hyperplasia of trabecular cells, some of which have come to lie free in the arachnoid meshes. An occasional free cell may be hematogenous. In *B* (AIP neg. 94299), from the cerebellar leptomeninges, most of the cells are hematogenous, consisting of lymphocytes, large mononuclears and an occasional neutrophil. Hypertrophied trabecular cells are scanty. Hematoxylin and eosin stain; × 500.

Gross Autopsy Observations.—Autopsy was performed eight hours after death. The combined weight of the lungs was 1,450 Gm. The bases of both lungs yielded bloody edema fluid. There was a small amount of mucopurulent secretion in the larger bronchi. The heart weighed 300 Gm. Its epicardium was smooth and revealed a few petechiae. The myocardium was rather flabby but otherwise appeared normal. A moderate subendocardial hemorrhage was noted on the septal wall of the left ventricle. The spleen weighed 110 Gm. and was deep red and soft. The liver weighed 1,600 Gm. and the kidneys 100 Gm. each; both organs appeared normal. The rest of the tissues, including the brain, also showed nothing of consequence on gross examination. Spinal fluid taken at autopsy contained 87.6 mg. of protein per hundred cubic centimeters and 175 cells per cubic millimeter; most of the cells were regarded as neutrophils. Cultures of lung tissue yielded Bacillus subtilis, and those of the heart and spinal fluid, no growth.

Microscopic Observations.—The heart muscle was the seat of a small hemorrhage. The lungs were congested, and many alveolar sacs contained bloody edema fluid. The liver showed a moderate centrolobular dissociation of cells, and there were a few leukocytes in the sinusoids; a moderate number of cytoplasmic vacuoles, which contained small inclusion-like bodies, were observed. In the adrenal cortex the intracellular lipid substance was equally distributed throughout the cortex but was slightly decreased in quantity. The bone marrow seemed appreciably less cellular than normal for a person in the patient's age group. There was a disproportionately large number of red cell progenitors in relation to the immature granulocytes. Whether this constituted an actual hyperplasia on the part of the nucleated red cells or only a relative increase due to loss of granulocytes could not be decided. Megakaryocytes displayed retrogressive changes, as evidenced by nuclear pyknosis, and even loss of nuclei, but there were considerable numbers of megakaryocytes which appeared normal. A somewhat larger portion of immature megakaryocytic forms than usual were seen, suggesting a regenerative effect. Throughout the marrow there were a moderate number of focal areas of degeneration. No alterations were observed in the remaining thoracic and abdominal viscera.

Study of the central nervous system revealed abnormalities in the leptomeninges and the parenchyma. In the leptomeninges of the cerebrum, brain stem and spinal cord, numerous trabecular cells exhibited reactive changes: Some were slightly enlarged, having spherical, densely chromatic nuclei and scanty cytoplasm, while others were larger and were composed of vesicular nuclei and abundant homogeneous cytoplasm; cells which had become detached from their trabecular framework, coming to lie free in the arachnoid meshes, had all the characteristics of mobile histiocytes (fig. 1*A*). A few lymphocytes were sometimes encountered in the vicinity of vessels. In the cerebellar leptomeninges there was a predominance of lymphocytes, and an occasional neutrophil was observed (fig. 1*B*). Small hemorrhages, mostly subpial, were observed in the leptomeninges of both the cerebrum and the cerebellum, and throughout the brain and leptomeninges the vessels were conspicuously engorged.

Changes in the brain were widespread and consisted of necrosis of ganglion cells, on the one hand, and proliferation of blood vessels, on the other. In the cerebral cortex, laminas III through VI were severely affected, many ganglion cells exhibiting shrinkage and other distortions. In moderate numbers of ganglion cells, the cytoplasm, when stained with hematoxylin and eosin, took on a reddish coloration, indicating early necrosis. More advanced necrosis tended to be focal in distribution, the cells in such areas showing pyknosis or disintegration of nuclei,

shrinkage of cytoplasm and chromatolysis (fig. 2 *A*). Often the entire cells were amorphous, as was the case particularly in Sommer's sector of the hippocampus (fig. 2 *B*), and to a somewhat less extent in the nuclei of the floor of the fourth ventricle. Of the other cerebral structures, the putamen and the caudate nucleus were the most affected, many foci of cellular necrosis being present

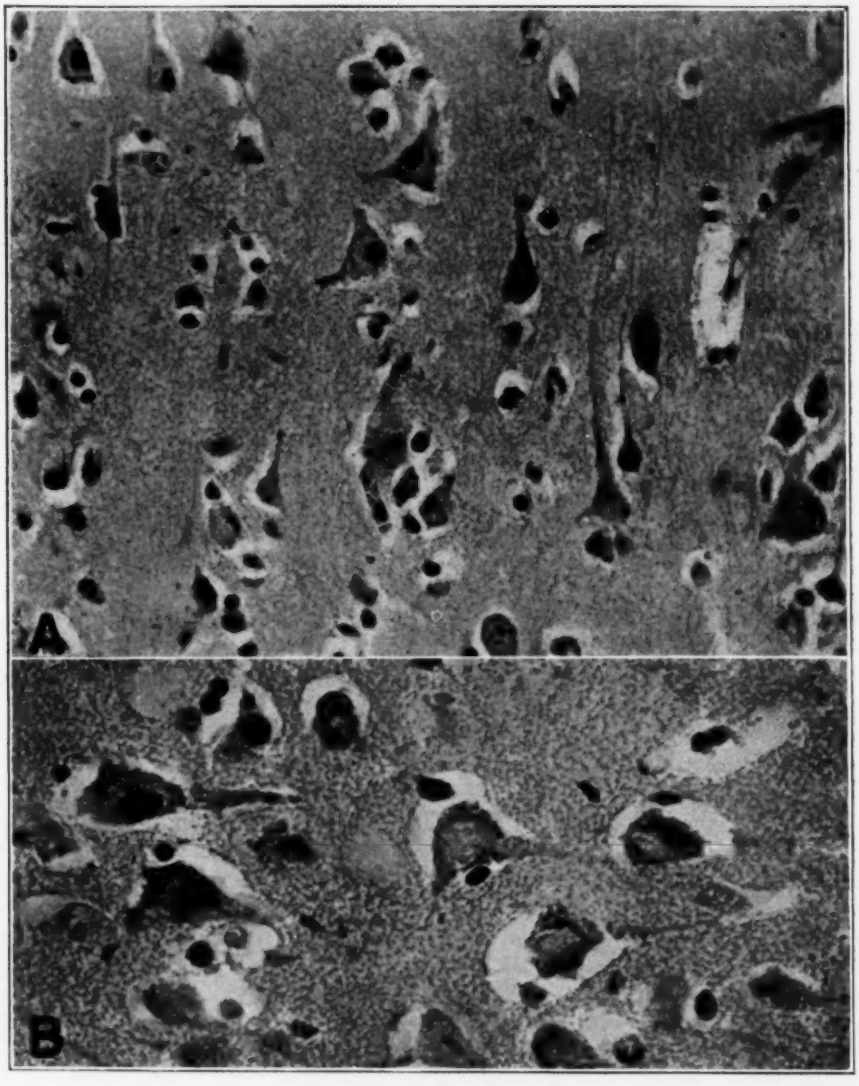

Fig. 2.—In *A*, from lamina IV of the cerebral cortex, virtually all the ganglion cells show evidence of necrosis. Cresyl violet stain; × 360 (AIP neg. 94263). *B* illustrates a similar breakdown of ganglion cells in Sommer's sector of the hippocampus. Same stain; × 500 (AIP neg. 94495).

(fig. 3). The globus pallidus was considerably less involved. The thalamus showed little of note, as was true also of the upper portion of the spinal cord. The cerebellum shared in the damage, many Purkinje cells being distorted or

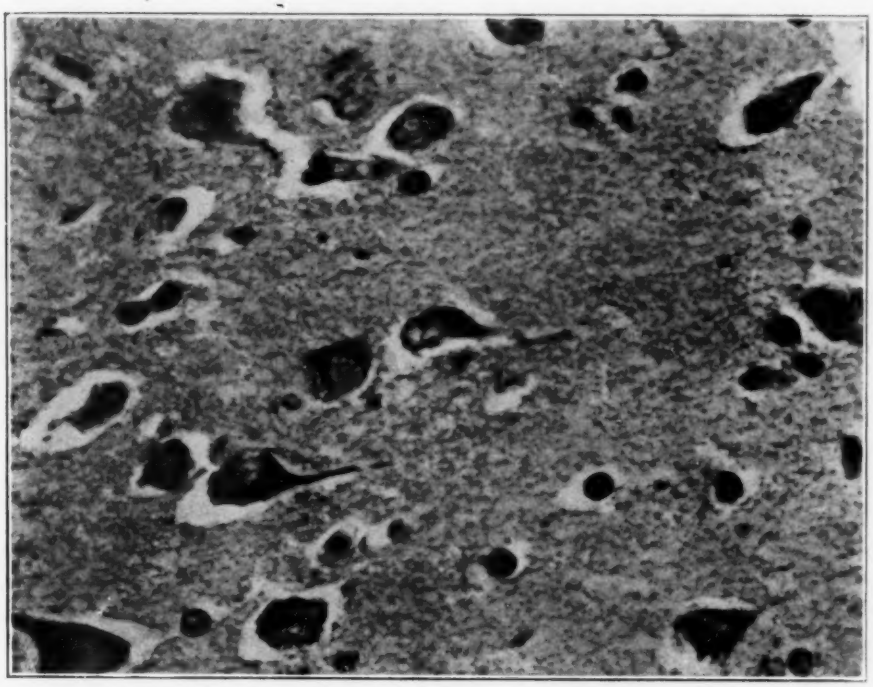

Fig. 3.—A focal area of disintegration of ganglion cells in the head of the caudate nucleus. Cresyl violet stain; × 550 (AIP neg. 94266).

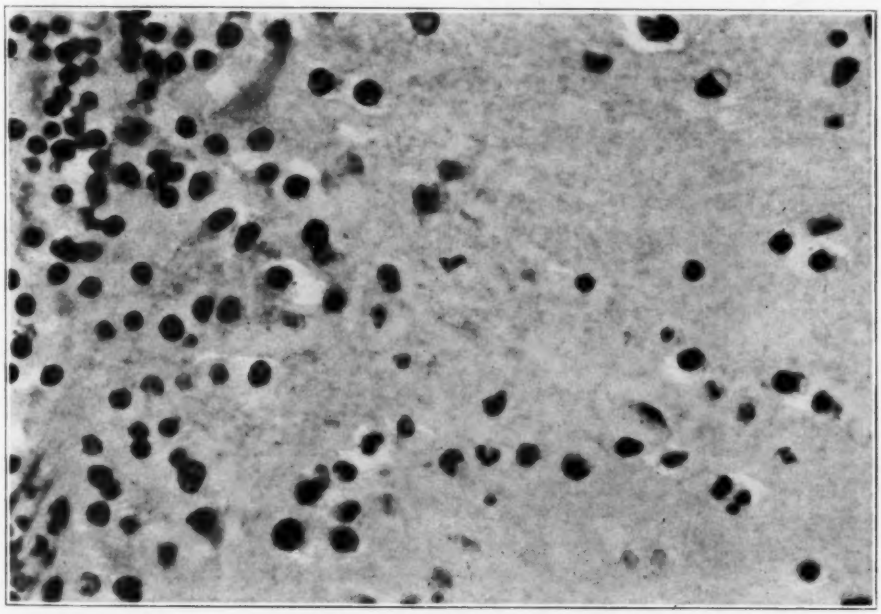

Fig. 4.—A section from the cerebellum, showing a number of hematogenous cells in the molecular layer, some of which are neutrophils. The "ghost" of a Purkinje cell is visible in the left upper portion of the photomicrograph. Hematoxylin and eosin stain; × 605 (AIP neg. 94307).

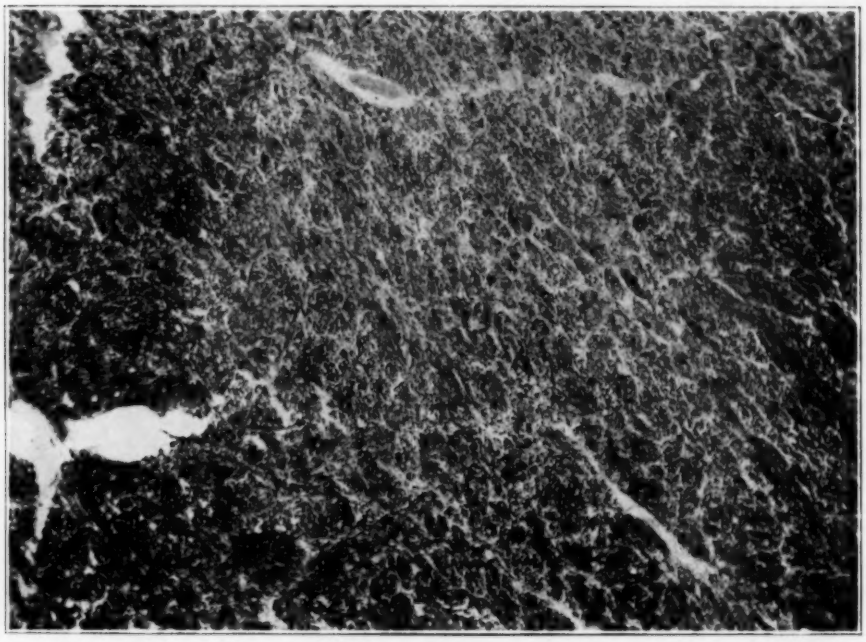

Fig. 5.—A focus of myelin rarefaction on the internal capsule. Lithium carbonate stain; × 44 (AIP neg. 94522).

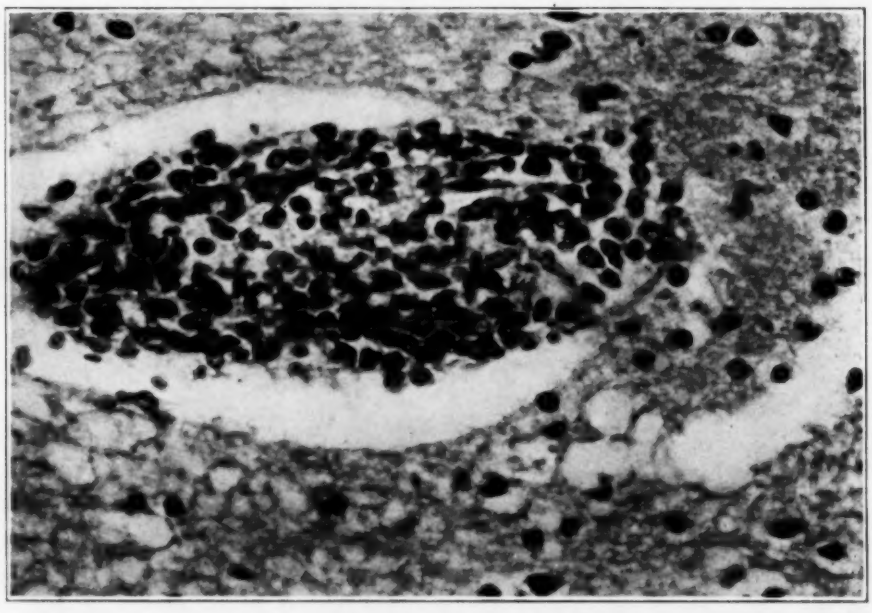

Fig. 6.—A blood vessel in lamina II of the cerebral cortex, displaying a large aggregation of cells in the adventitia and the Robin-Virchow space. Many of the cells have the configuration of lymphocytes. Others are large mononuclears, which may have come from the blood stream or originated from fixed adventitial cells. A few of the cells have invaded the adjoining parenchyma. Hematoxylin and eosin stain; × 489 (AIP neg. 94298).

completely disintegrated, and the molecular layer being invaded here and there by small groups of neutrophils and mononuclear cells (fig. 4). The dentate nucleus showed evidence of moderate cellular damage. Study of the spinal cord revealed disintegration, either partial or complete, in about 50 per cent of the anterior horn cells.

Special stains revealed considerable distortion and disintegration of the myelin of fibers coursing through the putamen, the caudate nucleus and the globus pallidus. Several areas of the internal capsule had a decreased affinity for the myelin stain, the most striking example of which is illustrated in figure 5. Axis-cylinders were not materially affected.

Scanty collections of perivascular lymphocytes were noted in the tegmentum of the pons, the floor of the fourth ventricle and the periventricular region adjacent to the caudate nucleus. Petechial hemorrhages, few in number, predominated in the subcortical white matter, the region of the fourth ventricle and aqueduct, and the nucleus basalis.

A striking feature of this case was the accumulation of mononuclear cells and occasional neutrophils in the adventitia of blood vessels, especially those of the upper laminas of the cortex; the cells, believed to be both hematogenous and of adventitial derivation, frequently extended into the adjoining parenchyma (fig. 6).

Comment.—The damage in the brain in this case was regarded as equivalent to decerebration. This would account for the severity of the opisthotonos, which, together with leukocytosis, led to the erroneous diagnosis of bacterial meningitis.

The widespread cellular necrosis in the brain, the presence of neutrophils in the parenchyma, the reactive changes in the trabecular cells of the leptomeninges, the scant perivascular exudation of inflammatory cells and the proliferation of adventitial histiocytes are all in keeping with the diagnosis of acute severe cerebral anoxia. Virtually the same degree of necrosis, mesodermal reaction and exudation of inflammatory cells was reported by Ginzler and associates [12] in dogs surviving for as short a period as sixteen hours after exposure to cyanide. Severe, and apparently irreversible, changes in ganglion cells without reactive changes may be evident at earlier periods after anoxic insult (Heymans and Bouckaert,[13] Cannon,[14] Gildea and Cobb [15]). There was a tendency in our case for the cellular necrosis to be focal, not only in the brain but also in the bone marrow, but no perivascular distribution of the necrosis was evident. Damage to walls of vessels, said to be a feature in anoxia

12. Ginzler, A.; Haymaker, W.; Bodansky, O., and Ferguson, R. L.: The Occurrence and Distribution of Lesions in the Central Nervous System of Dogs Subjected to Cyanide Poisoning, to be published.

13. Heymans, C., and Bouckaert, J. J.: Sur la survie et la réanimation des centres nerveux, Compt. rend. Soc. de biol. **119**:324-326, 1935.

14. Cannon, W. B.: Stresses and Strains of Homeostasis, Am. J. M. Sc. **189**:1-14 (Jan.) 1935.

15. Gildea, E. F., and Cobb, S.: The Effects of Anemia on the Cerebral Cortex of the Cat, Arch. Neurol. & Psychiat. **23**:876-903 (May) 1930.

(Hoff, Grenell and Fulton [16]), could not be established with any degree of certainty in our case, but there was a pronounced engorgement of capillaries and larger vessels, such as has been described by Yant and his associates [17] and others. The presence of cellular disintegration in nuclei of the floor of the fourth ventricle bears out the observations of Rotter,[18] Büchner [19] and Büchner and Luft [20] in experimental animals rendered anoxic by various means.

Demyelination, such as occurred in our case, is a variable observation in cases of anoxia. In case 2 of this paper, in which the conditions of the anoxic insult were similar to those in the preceding case, demyelination was absent. Likewise, in 2 instances of anoxia associated with cranial trauma, in which death occurred in one and seven weeks, respectively, and in which necrosis of gray matter was severe, there was demyelination in the first instance but not in the second (Malamud and Haymaker [21]). Myelin remained intact in a case of anoxia occurring as a result of nitrous oxide–oxygen anesthesia (Abbott and Courville [22]) and in the great majority of animals exposed to single sublethal doses of cyanide (Ginzler and associates [12]) but was profoundly damaged in animals repeatedly exposed to an oxygen-poor atmosphere (Morrison [23]). So far as we are aware, no common denominator for destruction of myelin in cases of anoxia has as yet been found.

The small cytoplasmic vacuoles in the liver in our case were of the same appearance as those observed by Pichotka,[24] Müller and Rotter [25] and Kritzler [26] in anoxic anoxia.

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16. Hoff, E. C.; Grenell, R. G., and Fulton, J. F.: Histopathology of the Central Nervous System After Exposure to High Altitudes, Hypoglycemia and Other Conditions Associated with Central Anoxia, Medicine **24**:161-217 (May) 1945.

17. Yant, W. P.; Chornyak, J.; Schrenk, H. H.; Patty, F. A., and Sayers, R. R.: Studies in Asphyxia, Public Health Bulletin 211, United States Treasury Department, Public Health Service, 1934, p. 1.

18. Rotter, W.: Ueber hypoxämische Veränderungen des Zentralnervensystems unter Sauerstoffmangelatmung bei normalen Luftdruck, Beitr. z. path. Anat. u. z. allg. Path. **101**:23-31, 1938.

19. Büchner, F.: Ueber experimentelle Höhenpathologie, Luftfarhtmedizin **5**:1, 1940

20. Büchner, F., and Luft, U.: Hypoxämische Veränderungen des Zentralnervensystems im Experiment, Beitr. z. path. Anat. u. z. allg. Path. **96**:549-560, 1936.

21. Malamud, N., and Haymaker, W.: Anoxia Associated with Cerebral Trauma: A Clinico-Pathologic Study of Three Cases, to be published.

22. Abbott, C. N., and Courville, C. B.: Degeneration of the Globus Pallidus After Nitrous Oxide Anesthesia, Bull. Los Angeles Neurol. Soc. **3**:46-50 (March) 1938.

23. Morrison, L. R.: Histopathologic Effect of Anoxia on the Central Nervous System, Arch. Neurol. & Psychiat. **55**:1-34 (Jan.) 1946.

24. Pichotka, J.: Tierexperimentelle Untersuchungen zur pathologischen Histologie des akuten Höhentodes, Beitr. z. path. Anat. u. z. allg. Path. **107**:117-155, 1942.

CASE 2.—*Clinical History.*—A white sergeant aged 22 was on an operational flight at an elevation of 24,000 feet (7,300 meters) on Feb. 7, 1945, when, in the course of caring for a wounded crew member, the tube of his oxygen mask became disconnected. He had been without oxygen for about ten minutes when, at 2:41 p. m., he was found prostrate and unconscious. His respirations were very irregular. The disconnected tube was attached to a regular outlet tube; "emergency rich" oxygen was administered, and then artificial respiration was commenced. After five minutes his breathing again became regular, but unconsciousness persisted. The bomber landed at 4:40 p. m. at an emergency field, and he was taken directly to a field hospital.

On examination there, the patient was cyanotic and spat up frothy blood. The blood pressure was 110 systolic and 68 diastolic, the pulse rate 100 and the respiratory rate 36. The rectal temperature was 99.8 F. With continued administration of oxygen, his color improved and he seemed tc comprehend statements, but he was unable to reply to questions or commands. On February 8 there was no change except for the development of a flame-shaped hemorrhage in the right fundus. Administration of oxygen was continued. On February 9 he exhibited "childish mannerisms." He was able to swallow fluids. The erythrocytes totaled 4,260,000 and the leukocytes 9,050 per cubic millimeter; the hemoglobin concentration was 84 per cent. His condition remained unchanged. Administration of oxygen by mask was continued.

On February 12 the patient was transferred to a general hospital. On arrival, his rectal temperature was 100.4 F., his blood pressure 150 systolic and 80 diastolic, his pulse rate 92 and his respiratory rate 20. His color was good and respirations regular. He seemed to have a vague comprehension of statements and apparently recognized objects but was unable to speak or make gestures. There was some ability to swallow. Neurologic examination at this time revealed hypoactive abdominal and cremasteric reflexes, normal biceps and triceps reflexes and hyperactive patellar and achilles reflexes, especially on the left side. The Babinski reflex was positive bilaterally. Ankle clonus could not be elicited. Extensor spasticity of moderate degree was present in all four extremities. The patient was responsive to painful stimuli.

Laboratory Data.—Studies on February 12 yielded the following data: hemoglobin, 14.8 Gm. per hundred cubic centimeters; leukocytes, 11,500, of which 74 per cent were neutrophils and 26 per cent lymphocytes; sedimentation rate (Wintrobe), 17 mm. in one hour; Kahn reaction of the blood, negative; urine, normal except for the presence of 5 to 10 erythrocytes and 6 to 12 leukocytes in each high power field of the centrifuged specimen. Roentgenograms of the skull and chest showed nothing abnormal. An electrocardiogram showed no abnormalities.

Further Course.—During the next three days, administration of oxygen was continued, fluids were given intravenously and penicillin therapy was begun. It was necessary to employ an indwelling urethral catheter. Hourly feedings were given through a nasal tube.

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25. Müller, E., and Rotter, W.: Ueber histologische Veränderungen beim akuten Höhentod, Beitr. z. path. Anat. u. z. allg. Path. **107**:156-172 (Sept.) 1942.

26. Kritzler, R. A.: Acute High Altitude Anoxia: Gross and Histologic Observations in Twenty-Seven Cases, War Med. **6**:369-377 (Dec.) 1944.

On Feburaty 16, i. e., on the ninth day after onset, the patient's temperature ranged from 101 to 103.6 F. The blood pressure averaged 136 systolic and 88 diastolic; the pulse rate was 120, and respiratory rate, 30. Convulsive seizures, during which the trunk became rigid and the extremities hyperextended, came on at intervals. They were quickly brought under control with the intravenous use of sodium amytal. At times the patient perspired profusely. Studies of the blood on February 16 revealed 13,000 leukocytes, of which 74 per cent were neutrophils, and a sedimentation rate of 47 mm. in one hour. Spinal fluid taken by lumbar puncture was under a pressure of 270 mm. of mercury; the fluid contained 3 leukocytes per cubic millimeter and 23 mg. of protein per hundred cubic centimeters; the Kolmer reaction was negative, and the colloidal gold curve was normal.

On February 20 the patient was still restless and occasionally cried out. At times his eyes were partly open. There were occasional convulsive seizures. Encephalographic studies revealed ventricles of normal size and position. The ventricular fluid was clear and was under a pressure of 270 mm. of mercury; it contained no cells; the total protein measured 16 mg. per hundred cubic centimeters; the colloidal gold curve was 123333210, and the Kolmer test gave a doubtfully positive reaction. An electrocardiogram was normal.

On February 26 the patient seemed somewhat improved. He was able to open and close his mouth and eyes on request. No convulsive seizures had occurred for several days. His color was good, and he seemed fairly alert. However, at 1:15 a. m. on February 27 his temperature commenced to rise, reaching 105.6 F. at 5 a. m. The blood pressure dropped from 108 systolic and 80 diastolic to 62 systolic and 42 diastolic, whereas the pulse rate increased from 140 to 160 and the respiratory rate from 30 to 50 per minute. Shortly after 5 a. m. the patient became dyspneic and coughed up about 100 cc. of clotted blood. There were repeated attacks in which the forearms flexed convulsively at the elbows and the hands at the wrists. The legs were not involved. The pupils were moderately dilated and equal in diameter. The eyes tended to deviate upward and outward. The fundi were normal. All the deep and superficial reflexes were hypoactive. No responses to painful stimuli could be elicited. The Babinski and Hoffmann signs were not elicited. Periodically the hands and fingers were fixed in flexion and the forearms and legs partly flexed. Blood transfusions were given.

During the night of February 27-28 the patient again had hemoptysis and lapsed into a state of shock. Transfusions of blood and plasma were again given. Peripheral vascular collapse and marked pulmonary edema became evident. Death occurred at 11:45 a. m. on February 28, twenty-one days after the onset of anoxia.

Gross Autopsy Observations.—Autopsy was performed two hours post mortem. The essential observations were as follows: The lungs weighed 750 Gm. Over each lower lobe posteriorly a subpleural hemorrhagic area, 2 cm. in diameter, was observed. The larger bronchi contained a small amount of blood-tinged mucus. The heart weighed 300 Gm. The myocardium was flabby but otherwise normal. The spleen weighed 125 Gm. and the liver 1,600 Gm.; neither exhibited abnormalities. Opposite the tracheal bifurcation the esophagus showed a superficial ulcer, 6 by 2 cm. in size. The edges of the ulcer were rolled. In the middle of the base of the ulcer there was a small sinus tract leading through the esophageal wall and into the uppermost portion of the left main bronchus. Here the bronchial mucosa showed a patchy reddened zone 1 cm. in diameter. Below the esophageal ulcer, and about 5 cm. above the cardiac end of the stomach, the mucosa was denuded over an area 4.5 by 1.5 cm. in size but was of natural color. The stomach contained about 1 liter of clotted blood but was otherwise normal. The

kidneys weighed 300 Gm.; section revealed no changes. The bladder mucosa was edematous and hemorrhagic. Culture of blood taken from the heart at autopsy yielded Staphylococcus aureus, and the urea nitrogen value was 81 mg. per hundred cubic centimeters. Grossly, the scalp, calvaria, dura, dural sinuses, leptomeninges and cerebral vessels appeared normal. The sphenoidal sinus contained mucopurulent material. The brain weighed 1,350 Gm. On section, the configuration, consistency and markings were in the normal range except for the lenticular nuclei, which were softened and spongy and presented small cavitations.

Microscopic Observations.—The lungs were the seat of moderately advanced lobular pneumonia. In the liver there was moderate to severe centrolobular necrosis. Some of the hepatic cells adjacent to the necrotic areas were hypertrophied. The spleen was moderately congested. In the midportion of the zona fasciculata of the adrenal cortex were many focal areas of large, foamy cells, which resembled those of the normal lipid-filled portions of the cortex, but in such areas moderate numbers of cells were devoid of nuclei and in other ways appeared disintegrated. The cells of the remainder of the cortex exhibited depletion of lipids, as judged by the appearance with the hematoxylin and eosin stain. The bone marrow of the femur was about 75 per cent cellular, whereas normally in persons of the

Fig. 7.—Section of the esophagus, showing an ulcer. The edges of the ulcer are rolled, and there is a heavy cellular infiltrate in the muscular and subserous coats. Hematoxylin and eosin stain; × 8 (AIP neg. 95258).

age group of the patient the marrow is almost entirely fat. All cell series participated in the hyperplasia, but granulocytes were strikingly in the foreground, neutrophilic myelocytes predominating. Megakaryocytes were abundant and appeared normal. Red cell progenitors were relatively sparse. The predominantly granulocytic hyperplasia was regarded, at least in part, as a response to the pneumonia. The bladder mucosa was edematous and hemorrhagic. In sections of the esophagus through the region of the ulcer the mucosa was absent, and there was an extensive exudative and productive reaction in the muscular and subserous coats (fig. 7). No other abnormalities of the thoracic and abdominal viscera were encountered.

Study of the central nervous system revealed reactive changes in the leptomeninges and degenerative changes or malacia in certain parts of the brain. In the leptomeninges, especially those overlying the cerebral cortex, moderate numbers of trabecular cells were in the process of developing into histiocytes (fig. 8 *A* and *B*), and the adventitia of vessels was hyperplastic (fig. 8 *B*). A similar, though less conspicuous, accumulation of cells was observed about larger vessels of the brain. Only in the region of the midbrain were lymphocytes noted in the arachnoid meshes, and they were sparse and perivascular in distribution. The cerebral cortex displayed degeneration of laminas III, IV and V at virtually

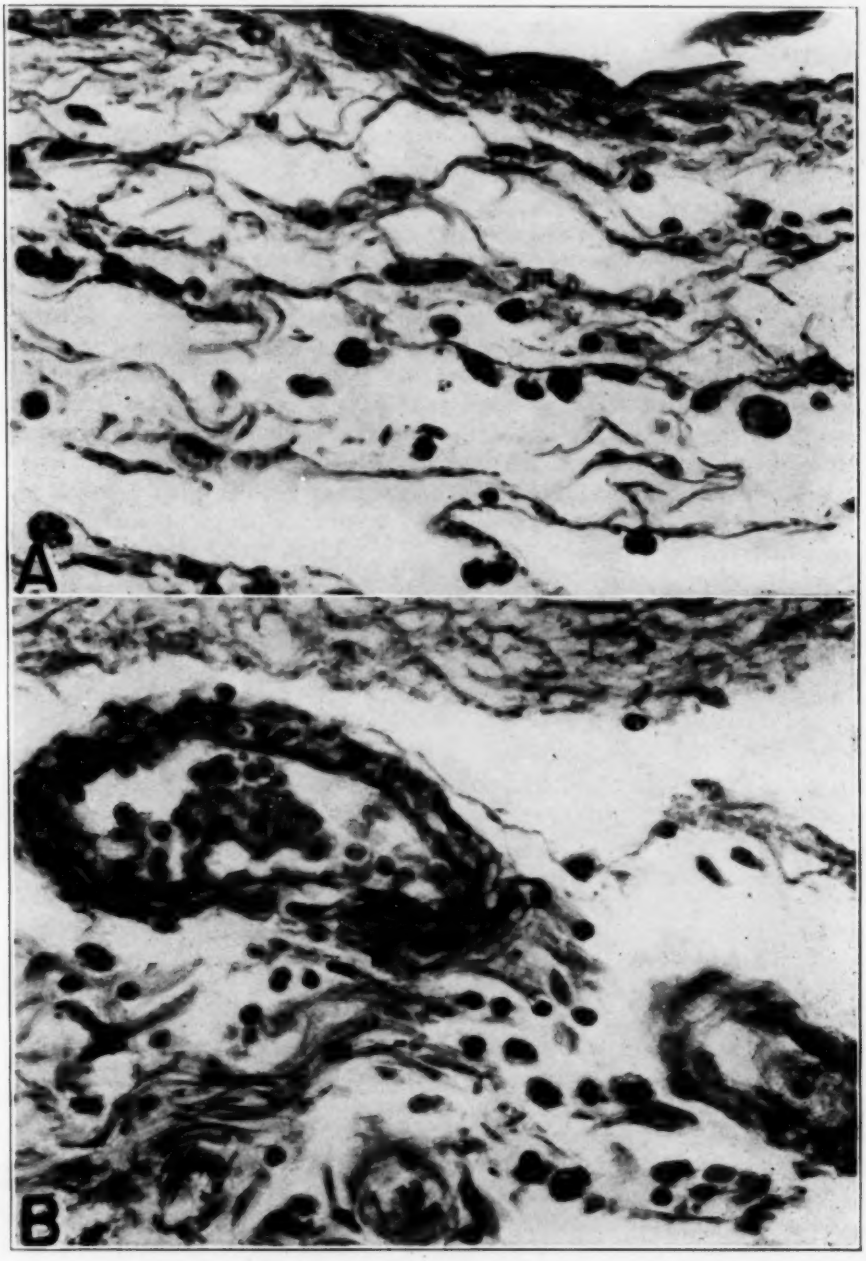

Fig. 8.—In *A*, from the cerebral leptomeninges, there are a number of cells in close relation to the trabecular framework and others in the arachnoid meshes. Virtually all are regarded as arising from fixed tissue cells of the arachnoid. Hematoxylin and eosin stain; × 550 (AIP neg. 94304). In *B*, the cells in the arachnoid are probably both hematogenous and of trabecular origin. The adventitial cells of the vessels are considerably hyperplastic. Same stain; × 605 (AIP neg. 94499).

all levels examined. The degenerative change varied from mild to severe, usually involving a contiguous gyrus or two and leaving unaffected the adjoining gyri. In areas damaged to the greatest degree, many ganglion cells were severely degen-

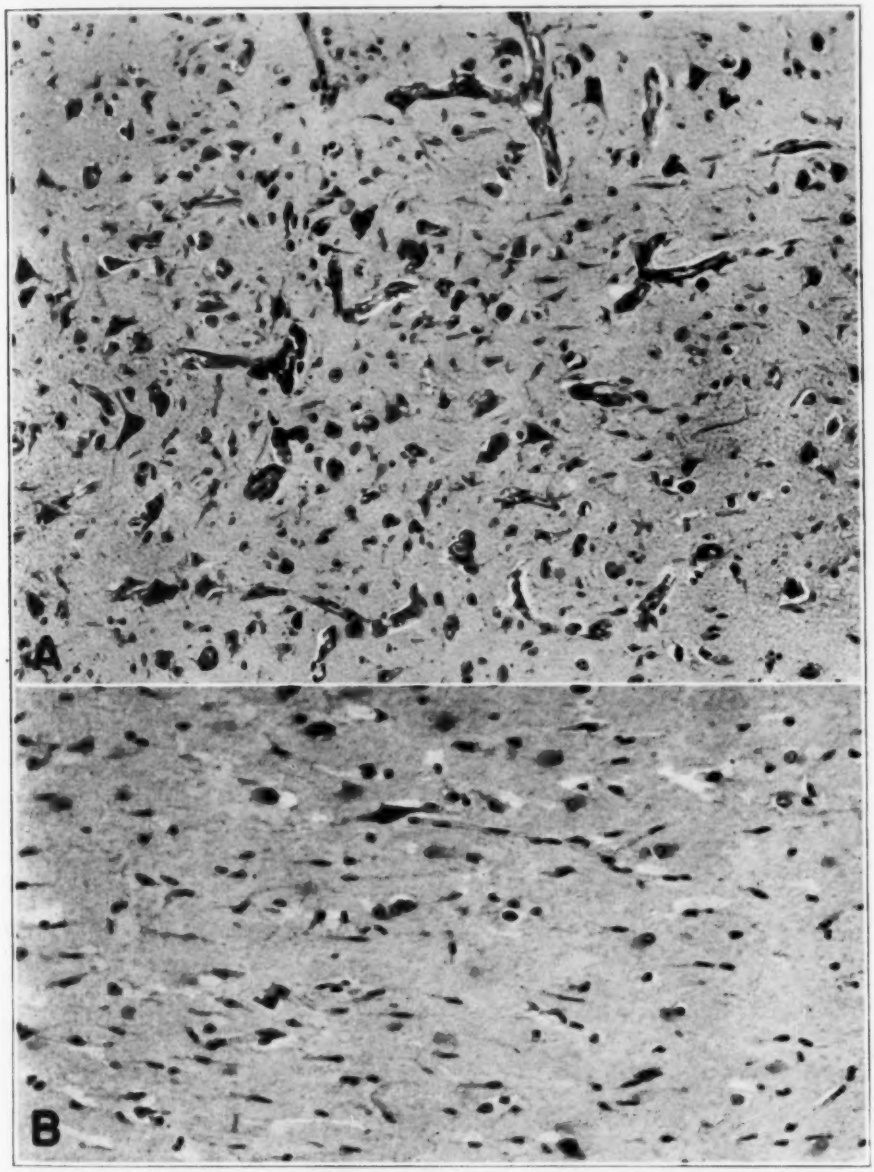

Fig. 9.—In *A*, from the deeper laminas of the cerebral cortex, numerous ganglion cells have disappeared and been replaced by hyperplastic and newly formed blood vessels, microglia and round mononuclear cells, some of which have the appearance of gitter cells. Some gyri of the brain showed more severe laminar degeneration than illustrated here, and others less. Cresyl violet stain; × 175 (AIP neg. 94287). In *B*, from Sommer's sector of the hippocampus, the entire width of the sector has been overgrown by microgliocytes and plump astrocytes, and there are moderate numbers of newly formed capillaries. Only an occasional ganglion cell remains. Same stain; × 187 (AIP neg. 94498).

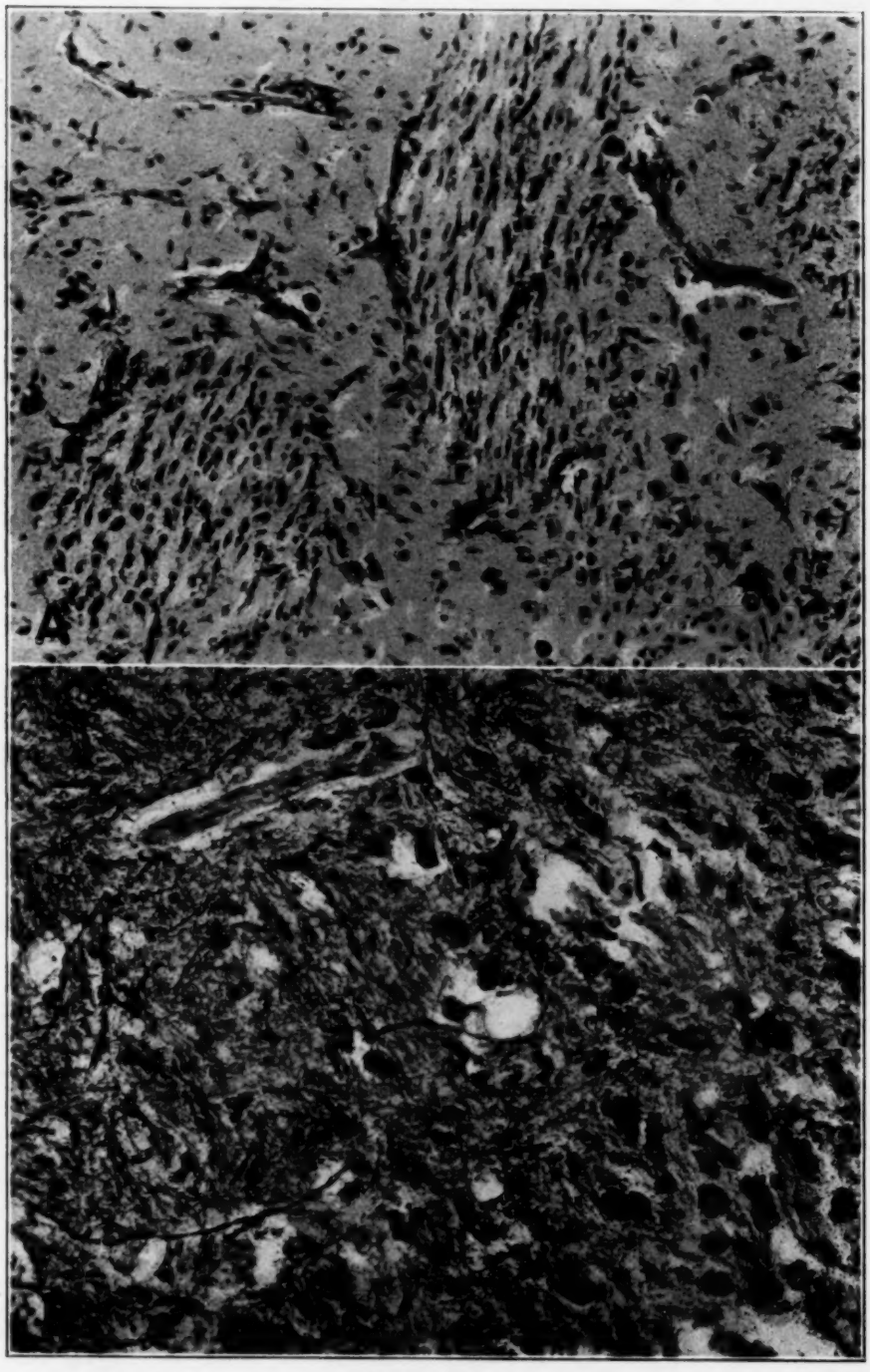

Figure 10

(See legend on opposite page)

erated or had completely disappeared, and vascular proliferation was well advanced. In addition, the degenerated laminas contained moderate numbers of cells having the configuration of microgliocytes. A moderately affected area of the cerebral cortex is illustrated in figure 9 *A*. Astrocytes and oligodendroglia appeared to be less scanty than normal. In the upper cortical laminas, mild reactive changes of vessels were apparent, but the ganglion cells seemed to be in a good state of preservation. In the hippocampus, virtually all the cells of Sommer's sector had disappeared and had been replaced with myriad microgliocytes and moderate numbers of plump astrocytes (fig. 9 *B*); other portions of the hippocampus were within the range of normal. The putamen showed massive malacia, most of the ganglion cells having disintegrated or disappeared and given way to hyperplastic and newly formed blood vessels (fig. 10 *A*). Groups of fibers traversing the putamen displayed remarkable hyperplasia of oligodendroglia and microglia (fig. 10 *A*), a feature not observed in the adjoining anterior commissure. Fat-laden gitter cells stopped short at the borders of the putamen, not affecting the globus pallidus (fig. 10 *B*) except in some sections, where the midportion of the external division of the globus pallidus had undergone necrosis. The caudate nucleus also showed cellular breakdown, formation of gitter cells and proliferation of blood vessels, but the degree of change was somewhat less than in the putamen. Special stains revealed that myelin and axis-cylinders were virtually absent in the putamen and had undergone a reduction in number in the caudate nucleus and in the degenerated laminas of the cerebral cortex; but elsewhere, including the cerebral white matter, the myelin and axis-cylinders were within the limits of normal. The diencephalon, midbrain, pons, medulla oblongata and upper portion of the spinal cord were relatively unaffected. In the cerebellum a moderate number of Purkinje cells had disappeared, and a few were in a state of denegeration. The Bergmann layer was unaltered. The molecular layer was within the range of normal except in isolated regions, where an occasional proliferation of glial cells was observed throughout the entire width of the molecular layer. The leptomeningeal vessels adjacent to such foci were surrounded by small accumulations of lymphocytes and occasional histiocytes. Slight degenerative changes were present in the dentate nucleus.

Petechial hemorrhages in the brain were scant, being most prominent in the wall of the third ventricle.

Comment.—In this case the structures of the brain vulnerable to anoxia were the lower laminas of the cerebral cortex, the putamen, the caudate nucleus, the portion of the pyramidal layer of the hippocampus comprising Sommer's sector and, to a limited degree, the external division of the globus pallidus and the cerebellum. In a series of dogs subjected to cyanide poisoning the necrosis was even more widespread,

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EXPLANATION OF FIGURE

Fig. 10.—In *A*, from the putamen, numerous ganglion cells have disappeared. What is left of the putamen is permeated by proliferated blood vessels, microglia and mononuclear cells, many of which are gitter cells. The cells grouped in fascicles are hyperplastic microgliocytes and oligodendrocytes, which have overgrown the fiber bundles normally present in the putamen. Cresyl violet stain; × 160 (AIP neg. 94284). *B* illustrates the transitional zone between the putamen and the globus pallidus. The putamen, to the right, is permeated by fat-laden gitter cells, whereas the globus pallidus is virtually free from them. • Sudan III stain; × 260 (AIP neg. 94491).

involving also the substantia nigra and the pulvinar of the thalamus (Ginzler and associates [12]). The relative sparing of the globus pallidus in our case is in contrast to the profound necrosis noted in anoxia associated with carbon monoxide poisoning (Semerak and Bacon,[27] Weil [28]), nitrous oxide–oxygen anesthesia (Lowenberg, Waggoner and Zbinden [29]; Abbott and Courville [22]), trauma (Malamud and Haymaker [21]) and severe secondary anemia (Overhof,[30] Scherer [31]) and in experimentally induced anoxic anoxia. The presence of severe damage to the cerebral cortex in both our cases is at variance with some reports in the literature (Büchner and Luft,[20] Rotter,[18] Campbell,[32] Dellaporta [33] that in anoxic anoxia the cortex is relatively spared. The relatively great involvement of the thalamus observed by Yant and associates [17] in anoxic anoxia was not present in our case.

CASE 3.—At approximately 1 p. m. on Oct. 7, 1944, a B 17 plane, on which the patient, a corporal, was a ball turret gunner, went into a bomb run at an altitude of 27,000 feet. A German 88 mm. shell exploded to the right of the ship, tearing a 5 by 8 foot (150 by 240 cm.) hole in the fuselage and killing two waist gunners. The oxygen apparatus was shot away, necessitating a descent to an elevation of 7,000 feet (2,100 meters). Because of damage to the plane, it was not possible to reach the ball turret gunner, who at the time of the explosion was rendered unconscious, and who remained so during the four and one-half hour return trip to the base.

On admission to a field hospital, at 6 p. m. on October 7, the patient was wildly delirious and very cyanotic. His pulse was rapid. All reflexes were hyperactive, and carpopedal spasm was present. Pentothal was administered intravenously to quiet him. He was kept warm. Two units of plasma was administered. Oxygen was given by the mask method.

Within a few hours the temperature was 100.6 F., the pulse rate 96 and the respiratory rate 24, and the blood pressure was 115 systolic and 75 diastolic. By

27. Semerak, C. B., and Bacon, L. H.: Experimental Lesions of the Brain from Carbon Monoxide, Arch. Path. **10**:823-839 (Dec.) 1930.

28. Weil, A.: Textbook of Neuropathology, ed. 2, New York, Grune & Stratton, Inc., 1945.

29. Lowenberg, K.; Waggoner, R., and Zbinden, T.: Destruction of the Cerebral Cortex Following Nitrous Oxide–Oxygen Anesthesia, Ann. Surg. **104**: 801-810 (Nov.) 1936.

30. Overhof, K.: Ueber das Vorkommen symmetrischer Gehirnerweichungsherde bei sekundärer Blutarmut, Virchows Arch. f. path. Anat. **287**:784-789, 1933.

31. Scherer, E.: Symmetrische Erweichungsherde im Globus pallidus bei sekundärer Anämie: Zugleich ein Beitrag zur Morphologie der Pseudokalkablagerung in Hirngefässen, Ztschr. f. d. ges. Neurol. u. Psychiat. **150**:632-639, 1934.

32. Campbell, J. A.: Note on Some Pathological Changes in the Tissues During Attempted Acclimatization to Alterations of O_2-Pressure in the Air, Brit. J. Exper. Path. **8**:347-351 (Oct.) 1927.

33. Dellaporta, A. N.: Die Veränderungen des Zentralnervensystems nach Luftverdünng und nach Hunger, Beitr. z. path. Anat. u. z. allg. Path. **102**:268-286, 1939.

October 8 he was semiconscious and still somewhat irrational. His pulse rate averaged 72, and the blood pressure was 130 systolic and 85 diastolic. A roentgenogram of the skull revealed no abnormality. Lumbar puncture revealed a normal cerebrospinal fluid pressure and 11 leukocytes per cubic millimeter of spinal fluid. Bradycardia developed, the pulse rate for two days ranging as low as 44 per minute.

On October 13 the patient was drowsy and was unable to swallow. He did not understand when spoken to. Neurologic examination revealed changes restricted to the left side: paresis of the face (of the central type), decrease in activity of the abdominal reflexes, a hyperactive achilles reflex and positive Hoffmann and Babinski signs. On October 17 the patellar and achilles reflexes were hyperactive, and the Babinski sign on the left side could still be elicited. When questioned, the patient grimaced and groaned but could not speak. As the days passed, he became somewhat more alert but in general remained severely retarded, both physically and mentally. The final diagnosis was that of organic psychosis due to cerebral concussion and anoxia. He was returned to the United States in the latter part of October 1944.

Comment.—In this case the patient is known to have survived for at least three weeks. His physical and mental incapacitation were similar to that in case 2. These 2 cases, as well as that of Church and Loeser,[7] referred to earlier, are apparently the only ones on record in which sublethal anoxic anoxia produced severe sequelae.

SUMMARY

Three cases of anoxic anoxia occurring in aviators while engaged in combat are presented in detail. In 2 cases the anoxia proved fatal in forty hours and three weeks, respectively, and in the third instance the patient was observed for a period of three weeks and then was transferred to the United States. The degree and duration of anoxia in each case are not completely known. In the first, the accident occurred at an elevation of "more than 20,000 feet," the patient being found unconscious five minutes after completion of a bomb run, at which time resuscitation was commenced. In the second, the patient was exposed to an atmosphere at 24,000 feet for approximately ten minutes. In the third, it was at 27,000 feet that the oxygen tank of the plane was shot away, necessitating a rapid descent to 7,000 feet, during which time no effort could be made to revive the patient.

In the case of approximately forty hours' duration (case 1) a conspicuous necrosis of ganglion cells was observed in laminas III to VI of the cerebral cortex, the striatum, the cerebellum, Sommer's sector of the hippocampus and the anterior horns of the spinal cord, mostly focal in character, and degeneration of myelin in the internal capsule. Also observed were early proliferation of the fixed tissue cells of the leptomeninges and vascular adventitia and mild exudation of lymphocytes and neutrophils into the meshes of the arachnoid, the perivascular spaces and, to a limited extent, the parenchyma of the brain. In the case of

three weeks' duration (case 2) the changes were of virtually the same location except that the cerebral white matter, brain stem and spinal cord were relatively spared. The profound damage in these cases of sudden and severe anoxic anoxia is strikingly similar to that observed in some of the other forms of anoxia.

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CEREBELLAR MEDULLOBLASTOMA IN ADULTS

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AND

FRANCIS C. GRANT, M.D.

PHILADELPHIA

IN A RECENT survey of 97 consecutive cases of verified medulloblastomas, we noted that 30 patients were 16 years of age or older (fig. 1). The syndrome of the cerebellar medulloblastoma in childhood has been repeatedly emphasized, whereas the occurrence of similar tumors in the adult has received scant attention in the literature.

Cushing,[1] in 1930, reported 61 cases of medulloblastoma, in 21 per cent of which, or 13, the patients were over the age of 16. Ten patients

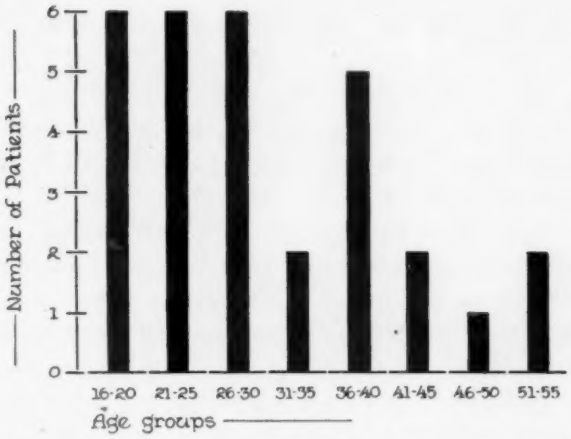

Fig. 1.—Age distribution of 30 verified cases of cerebellar medulloblastoma in adults.

were between the ages of 16 and 30, and 3 were in the age group over 30. His oldest patient was 38.

Dyke and Davidoff [2] discussed a series of 16 cases of verified medulloblastoma, in which the oldest patient was 24 years of age. They were

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1. Cushing, H.: Experiences with Cerebellar Medulloblastomas: Critical Review, Acta path. et microbiol. Scandinav. **7**:1-86, 1930.

2. Dyke, C., and Davidoff, L.: Roentgen Treatment of Disease of the Nervous System, Philadelphia, Lea & Febiger, 1942, p. 81.

impressed with the fact that 3 of their 16 patients were over 20 years of age.

In our own series, of 97 patients, 31 per cent were 16 years of age or older. Of these, 16 were in the age range of 16 to 30 years, and 14 were over 30. Our oldest patient was 55.

SEXUAL INCIDENCE

Cushing's series contained 10 male patients and only 3 female patients over the age of 16. In our somewhat larger series, 18 were females and 12 males. On the basis of the combined figures in the two series, there is no significant statistical difference in the sexual incidence of cerebellar medulloblastoma in the adult.

DURATION OF SYMPTOMS

The average duration of symptoms prior to operation was 3.8 months. The extremes were 1 month and 9 months. This spread is approximately what was found in our series of medulloblastomas occurring in childhood. It had been our previous impression that the average preoperative duration of symptoms in the older age group was considerably greater than that in childhood.

LOCATION OF THE TUMOR

Cushing and others have emphasized that in the adult these tumors are located chiefly in the cerebellar hemispheres, while in childhood they generally occur in the vermis.

In our own series of cases, 15 tumors were limited to one or the other cerebellar hemisphere. Twelve tumors were limited to the vermis, and 3, which had evidently begun in the vermis, later involved one of the hemispheres. This distribution, therefore, does not suggest that the cerebellar hemispheres are the more likely site of the tumor in adults but reveals a distinctly greater tendency to involvement of the hemispheres in adults than in children.

SYMPTOMS

The unvarying location in the midline of the cerebellar medulloblastoma in children leads to an early and a typical clinical syndrome—the triad of increased intracranial pressure, headache, vomiting and papilledema, without focal signs of cerebellar involvement, but soon followed by evidence of trunkal dyssynergia.[3]

On the basis of the more frequent occurrence of the hemispheric variety in adults, another clinical syndrome was postulated by Cushing, characterized by early objective evidence of cerebellar disturbance. The primary location of the tumor in the adult group was almost equally

3. Grant, F. C.: Clinical Study of Midline Cerebellar Tumors in Children, S. Clin. North America **9**:1155-1168, 1929.

distributed between vermis and hemisphere. However, in 80 per cent of the hemispheric type definite signs of increased intracranial pressure, such as headache, nausea, vomiting and visual changes, were first to appear with focal cerebellar symptoms following at varying intervals. On the other hand, in 25 per cent of the lesions primary in the vermis the onset was with cerebellar symptoms:

It may be argued that the patient is less likely to notice the fine nuances of cerebellar dysfunction, whereas he is early cognizant of headache. Nevertheless, Cushing was impressed by the early appearance of cerebellar signs in his patients.

Our figures fail to support the hypothetic syndrome of cerebellar medulloblastoma in the adult. Regardless of location, the vast majority of the patients first showed signs of acute progressively increasing intracranial pressure.

PATHOLOGIC PICTURE

Twenty-one medulloblastomas were soft and widely infiltrating, and 9 were fairly discrete and somewhat firmer to palpation. Unfortunately, it seemed to make little difference in the eventual survival of the patient whether or not the tumor was originally described as grossly discrete or widely infiltrating.

Bailey [4] and associates stated that a few of the so-called medulloblastomas seem to contain more connective tissue than usual and that this variety is likely to occur in adults. This was not true of the cases in our series. Microscopically these tumors in adults were indistinguishable from tumors in a large number of our younger patients (fig. 2).

Of the 21 cases with adequate follow-up observations, the presence of seeding was verified, either at operation or autopsy, in 8, or 38 per cent. The original tumor in 1 of these 8 cases was so discrete as to have been apparently completely removed at operation; yet at reoperation, one year later, seeding tumors were removed from the cauda equina. In the other 7 cases of seeding the primary growth widely infiltrated the cerebellum. In 2 other instances seeding was suggested symptomatically but was never proved.

THERAPY

A consistent plan of action was used in all our cases. An attempt was made in every instance to restore the circulation of the cerebrospinal fluid by unblocking the aqueduct and the fourth ventricle. This often required the removal of large amounts of tumor.

All patients were given adequate radiation therapy according to the methods outlined by the department of radiology of the Hospital of the University of Pennsylvania.[5] On a number of occasions repeated

4. Bailey, P.; Buchanan, D., and Bucy, P.: Intracranial Tumors of Infancy and Childhood, Chicago, University of Chicago Press, 1939, p. 71.

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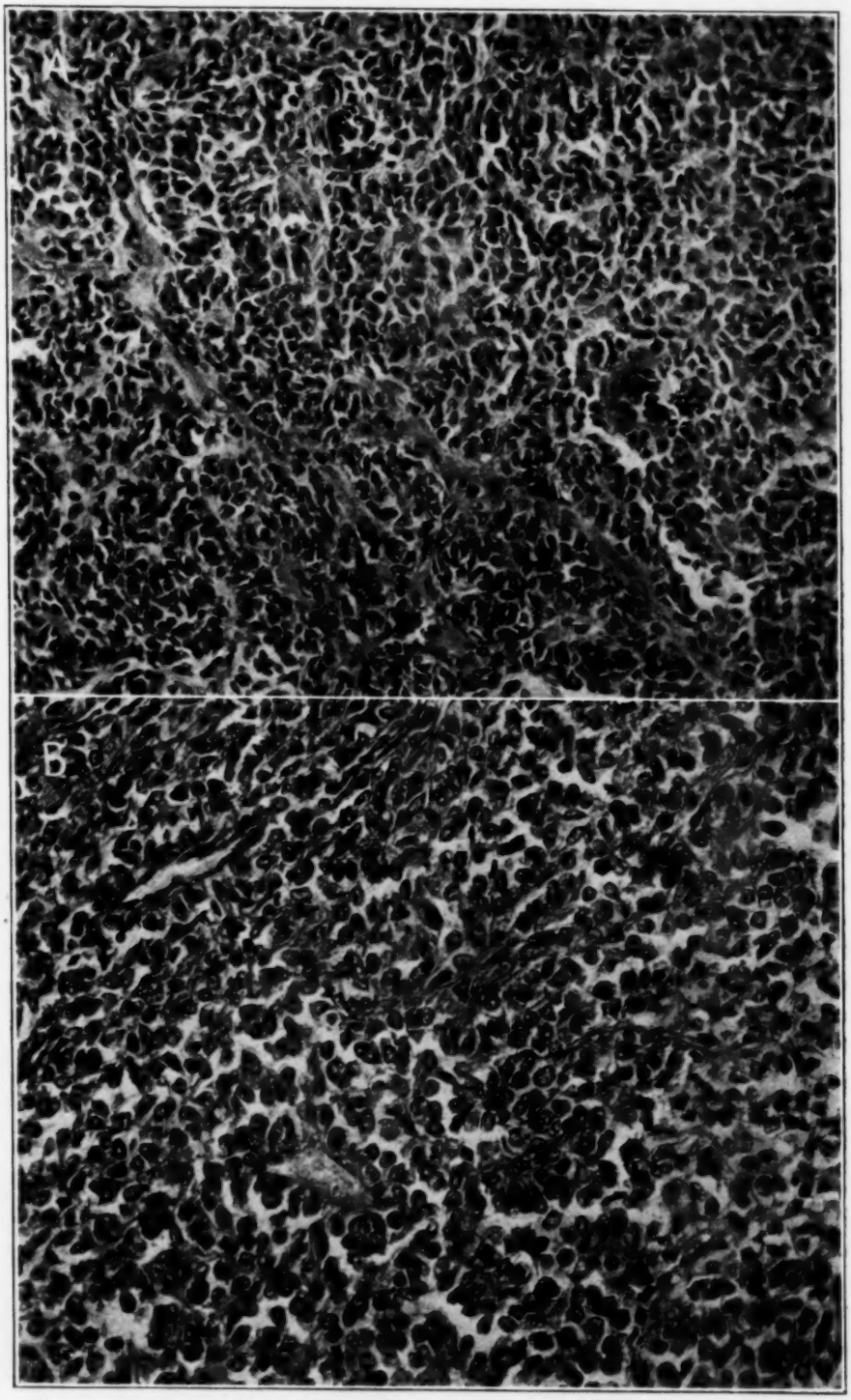

Fig. 2.—Histologic appearance of representative tumors in this series. Hematoxylin and eosin stain; × 336. *A*, section of a tumor of a man aged 43, who was alive six years after radical removal of the tumor and three courses of irradiation therapy. *B*, section of a tumor of a woman aged 38, with five years' survival following radical removal of the tumor and two courses of irradiation therapy.

ventriculoencephalograms, made at the instigation of Dr. E. P. Pendergrass, enabled us to treat the recurrent or seeding tumor before clinical signs were present. Various authors have claimed that radiation therapy with decompression has given results as good as, or better than, attempted radical removal of these tumors followed by roentgen irradiation. Our unvarying operative plan does not permit of comparative studies. However, the statistics on survival for this series might serve as a basis for comparison by others.

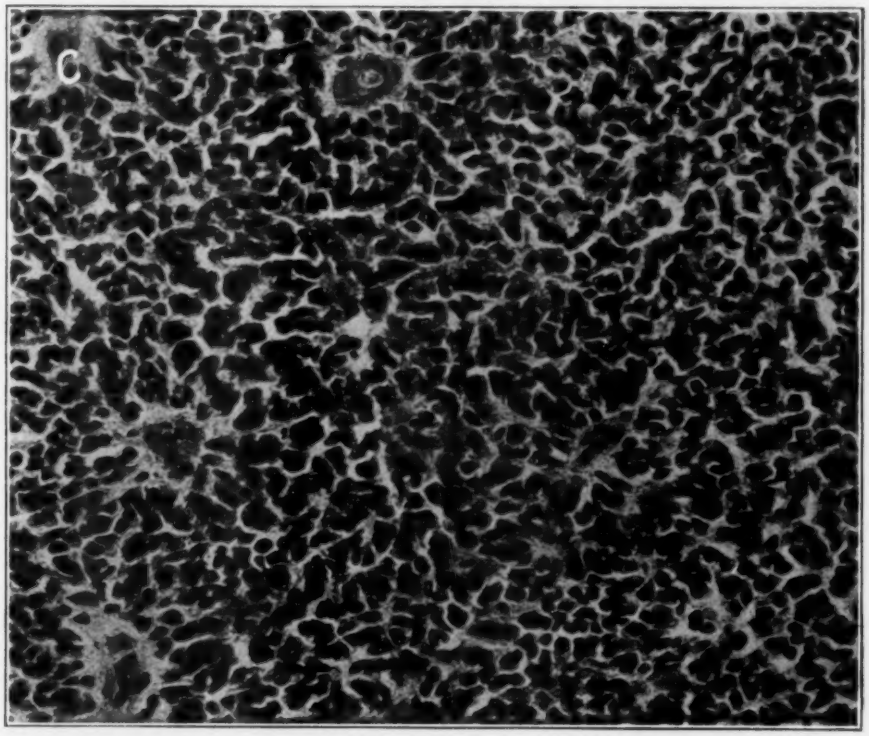

Fig. 2.—*C*, section of a tumor of a youth aged 16, alive eight years after radical removal of the tumor and four courses of irradiation therapy.

SURVIVAL

It is the general impression that the period of survival for medulloblastomas in adults is somewhat longer than that for medulloblastomas in childhood, no matter what therapy is used.

In our series, 2 patients were not adequately followed, although both are known to have survived at least one year after operation. One

5. Pendergrass, E.; Hodes, P., and Godfrey, E.: The Radium Treatment of Cerebellar Medulloblastoma: Report of Thirty-One Cases, Am. J. Roentgenol. **48**:776-789, 1942.

patient died before operation and 6 within thirty days of the operation. Of the 21 patients with adequate follow-up data, 1 survived for six months, 3 for twelve months, 4 for two years, 4 for three years, 5 for four years and 1 each for five, six, seven and eight years. Three patients are still alive, three, six and eight years after operation (fig. 3). Thirteen patients, or 62 per cent, survived for three or more years after operation. Nine patients, or 43 per cent, lived for four years or more. Five patients, or 24 per cent, survived for five years or more.

These figures speak for themselves and are definitely at variance with what we found in our childhood group, in which no patient under the age of 16 survived for more than three and a half years.

There did not appear to be any relation between the gross or histologic appearance of the tumor and the ultimate outcome. The patients with

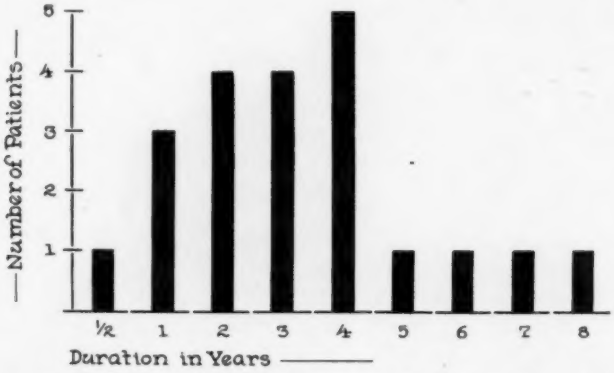

Fig. 3.—Postoperative survival period of 21 adults with verified cerebellar medulloblastomas.

well demarcated tumors fared no better or worse than those with obviously infiltrating ones.

CONCLUSIONS

Cerebellar medulloblastoma is not an unusual tumor in the adult.

Medulloblastomas in adults occur more frequently in the cerebellar hemispheres than do similar tumors in childhood. In our series occurring in adults, approximately 50 per cent were primarily hemispheric in location.

Regardless of this difference in site of origin, the clinical picture in adults did not differ from the usual syndrome noted in childhood.

Seeding occurred in 38 per cent of our patients who were adequately observed.

The tumors were histologically identical with medulloblastomas of the childhood group.

The survival period in adults as a group was definitely longer than that in children.

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STATIC TREMOR WITH HEMIPLEGIA

Report of a Case: Development, Progression for Seven Years and Postmortem Histologic Observations

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THE CASE reported here is that of a child with tremor and paresis of the right side which developed over a period of seven years and which was due to a tumor involving the left side of the midbrain and thalamus.

REPORT OF CASE

History and Examination.—M. I. H., a 6 year old girl, came to the Vanderbilt Clinic on Dec. 18, 1936, with a history of increasing tremor of the right antebrachium. This tremor was first noticed on December 8. On December 15 the child was dragging her right foot and there was some tremor of that leg. On December 17 facial asymmetry with overactivity of the left side of the face was observed. Examination disclosed an intention tremor of the right extremities, so severe in the arm that the patient could not write; paresis of the muscles of the right side; absence of the right plantar response, and a patellar clonus on the same side. The child was admitted to Babies Hospital to exclude the presence of a brain tumor.

On the following day the hospital physician recorded no impairment of sensation, a negative Romberg sign, absence of the right abdominal reflexes, positive Babinski and Chaddock signs on the right side, absence of Hoffmann and Mayer signs on this side and a hemiplegic gait. It was his impression that the tremor was present in all muscles of the right upper extremity and shoulder girdle and that it was present at rest, moderately increased when movement was attempted but voluntarily controllable for short periods. Observation when the child was asleep revealed the absence of tremor. On ophthalmologic consultation there were no significant ocular findings.

The neurologic consultant expressed doubt about the right plantar response, stating that this reflex was poorly elicited but that the right hallux remained in the Babinski position most of the time. It was his opinion that the tremor was present in the right leg and the right side of the "trunk" as well as in the arm and was constantly present at rest and during movement, varying only slightly in response to change of position of the arm. He asked for a spinal tap, determination of the sedimentation rate and a roentgenographic examination. The spinal puncture revealed an initial pressure of 50 mm., which rose well on jugu-

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lar pressure. A roentgenogram of the skull disclosed no abnormalities. Two weeks later the neurologic consultant stated the opinion that the tremor was more intense and constant, reaffirmed its presence at rest and during movement and noted that it became worse during movement. He also felt that the paresis was more

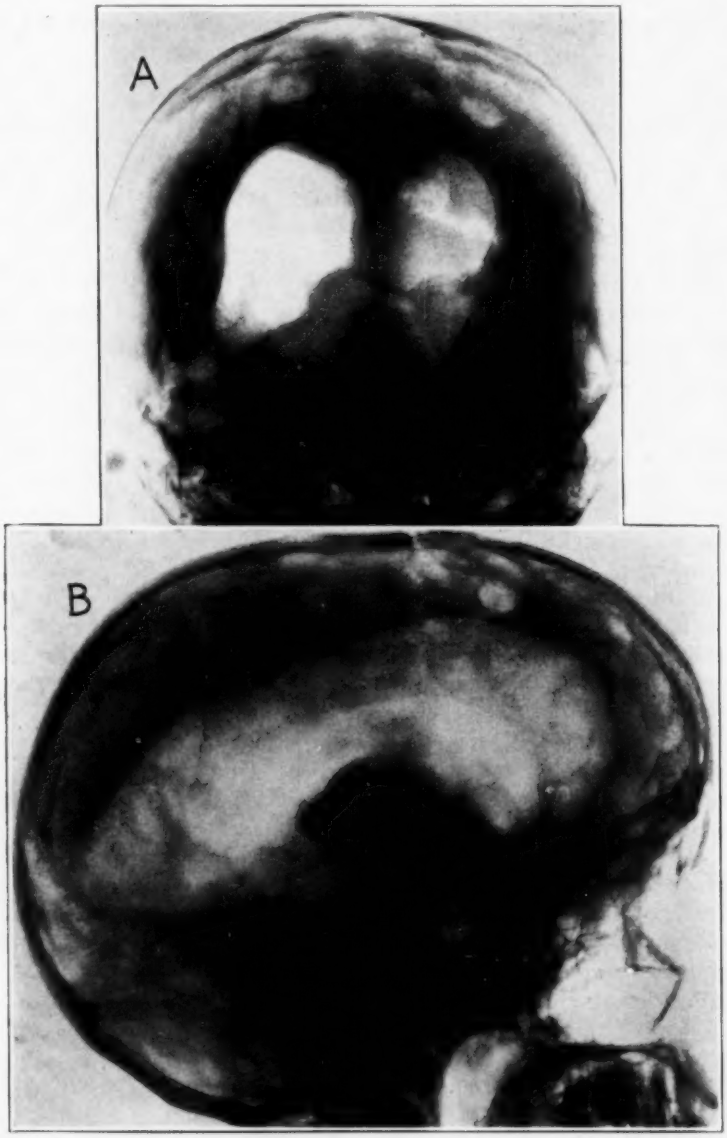

Fig. 1.—*A*, anteroposterior and, *B*, lateral ventriculogram (May 7, 1942).

severe. Examination of the visual fields revealed pronounced concentric constriction of the right field but no abnormality of the left. A pneumoencephalogram (Jan. 8, 1937) disclosed enlargement of the lateral ventricles, especially the left. The left side of the hypothalamic portion of the third ventricle was encroached

on, and there was a concave defect in the rostral margin of the cisterna pontis. The aqueduct and the fourth ventricle were not abnormal. The late Dr. Dyke expressed the opinion that the patient had a suprasellar tumor located to the left of the midline. After the pneumoencephalographic procedure the patient required codeine and phenobarbital. Under such circumstances the tremor could not always be detected at rest but was brought out by voluntary activity (January 10).

Reexamination by the neurologic consultant on January 21 and 28 disclosed that the paresis and tremor had progressed. The gait, in particular, was further impaired. His opinion was shared by the house officer who examined the patient on February 1. He also observed that there was a certain amount of wasting of the muscles of the right hand and that the patient was having difficulty in concentrating and remembering and had become euphoric. A psychiatric consultant concurred in this opinion. Ophthalmologic consultation revealed inadequacy in convergence. Examination of the visual field could not be satisfactorily completed.

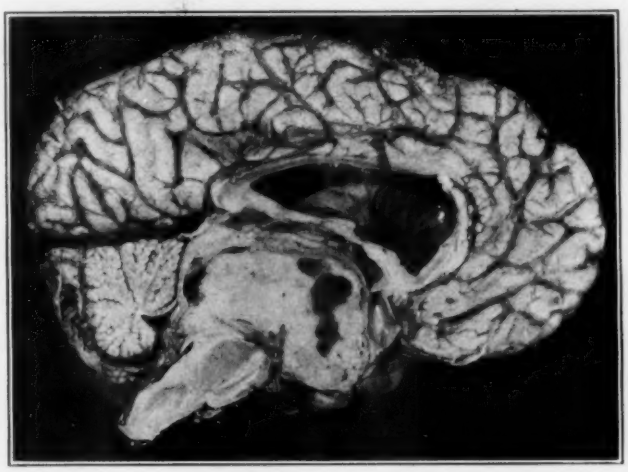

Fig. 2.—Left side of the brain.

Progression.—The patient was transferred to the Neurological Institute of New York, where it was decided that the tumor was inoperable and several courses of high voltage roentgen therapy were given. There was temporary improvement, but deterioration again became progressive in June. There was vomiting; difficulty in speaking developed; the left side of the body became weak, and there was a tendency to fall forward. Papilledema was observed in the right eye.

Examination in September revealed paresis of the right side of the face and right convexity of the upper portion of the spine with left convexity in the thoracic region. The right arm was maintained in a position of flexion and was constantly in motion, the movements varying in type (flexion, extension and rotation) and in frequency and force. This activity was increased by attention or use. There were occasional myoclonic movements of the other extremities, involving the right leg particularly and the left leg least. The right upper extremity was useless; the right lower was paretic, and the patient could not stand or walk unaided and was ataxic even when seated. There was resistance to passive movement of the right upper extremity. This resistance was broken by

interference of the tremor. Dysarthria was pronounced. The Babinski phenomenon was encountered bilaterally, and "confirmatory" signs and reflexes were present. Papilledema was observed in both eyes. The patient remained under observation during the last two weeks of September and the first two weeks of October and was found to deteriorate throughout this period.

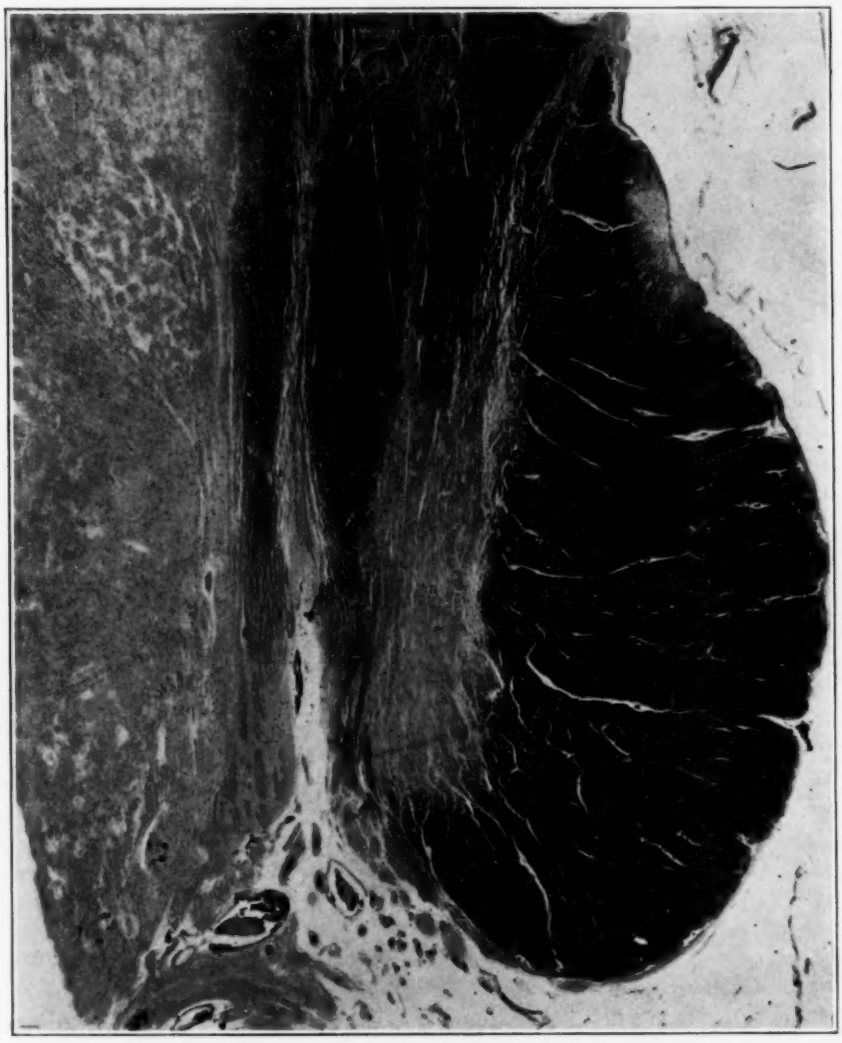

Fig. 3.—Section through the mesencephalon, showing destruction of the left side of this portion by tumor and preservation of the right basis pedunculi.

Episodes of severe headache and vomiting continued to occur at progressively shorter intervals throughout the next five years, and there was increased failure of vision. During April and May of 1942 she was seen by one of us (L. D.). At that time she presented the appearance of right hemiplegia, including facial paralysis, right wrist drop and a flexor position of the fingers. There was a static, rhythmic tremor, which was accentuated when her attention was distracted.

The report stated: "The deep reflexes were increased. A Babinski phenomenon, with all confirmatory signs and reflexes, was present bilaterally, being greater on the right side than on the left. The abdominal reflexes were diminished on the right." The right pupil was larger than the left; both pupils reacted poorly to light and better in accommodation. The eyegrounds suggested atrophy of the optic nerve.

A ventriculogram showed dilatation of both lateral ventricles (fig. 1 *A* and *B*). The third ventricle was displaced to the right. The dorsum sellae had disappeared, as had the posterior clinoid processes.

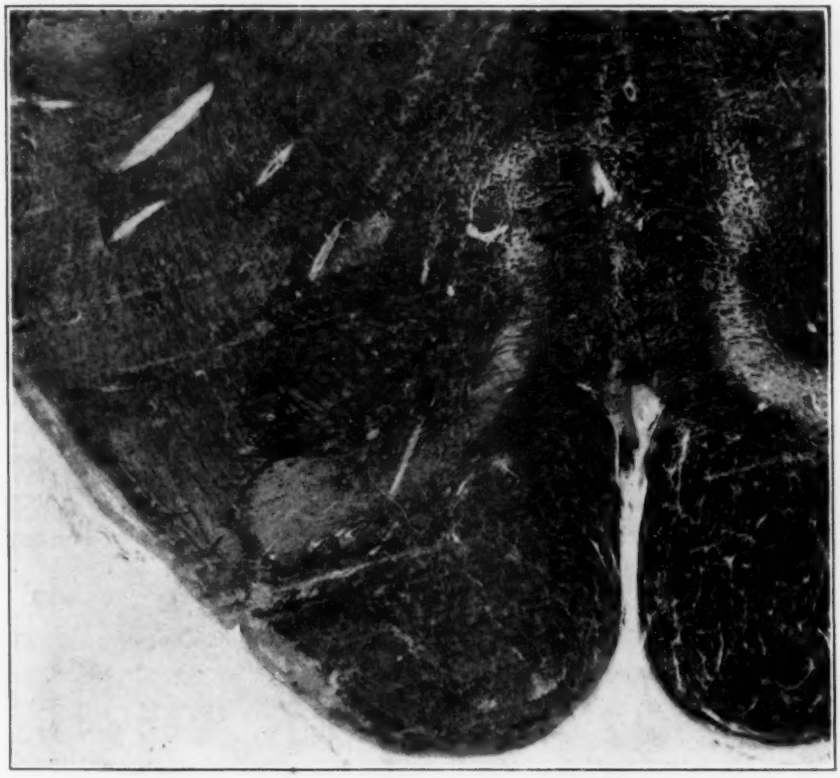

Fig. 4.—Section through the lower end of the inferior olives, showing a degenerated left pyramid and a well stained right pyramid.

On or about July 10, 1943 the patient was seen by one of us (R. G.), who observed a discharge of cerebrospinal fluid. The child was blind and showed "right hemiplegia, with a transient type of tremor in the right upper extremity. The left extremities were also severely paretic." The child died on July 20, 1943, and postmortem examination was performed in King's County Hospital (prosector, Dr. I. Garrow) on the date of death.

Autopsy.—The body was wasted and showed atrophy of the muscles of the right upper extremity. The right wrist and elbow were acutely flexed. The left frontal region exhibited a scar 7 cm. in length. In this region the soft tissues were only loosely attached to the underlying bone, which exhibited two trephine openings, one on either side of the midline and 2 cm. rostral to the frontoparietal

suture. When the calvaria was removed, 0.5 liter of clear cerebrospinal fluid escaped. The brain was removed, fixed and sent for study to the laboratory of Dr. E. Jefferson Browder, in Kings County Hospital. The sella turcica measured 3.2 by 3.5 cm. The pituitary body was compressed.

The remainder of the autopsy is of no importance for the purposes of this report. The anatomic diagnosis was meningitis and cerebral tumor.

Toward the end of 1944 the brain was sent to the laboratories of the department of neurology of the College of Physicians and Surgeons for further study.

Gross Appearance of the Brain.—The brain presented a compressed appearance. The reason was apparent on sagittal section, which revealed a massive polar spongioblastoma located in the position of the diencephalon and mesencephalon. Its position is well shown in the accompanying photograph (fig. 2). It lay in the tissue of the left side of the midbrain and thalamus and had displaced the substance of the right side of the brain far laterally.

Histologic Study.—Histologic examination proved instructive. The left side of the thalamus was quite destroyed by the tumor, which continued through the left side of the mesencephalon and terminated by burrowing through the lower part of the anterior medullary velum into the fourth ventricle. There was no evidence that any of the nuclei of the left side of the mesencephalon remained intact, and all the fiber systems of this region, except for a few fibers, were destroyed; but the mechanisms of the right side, while displaced, were all in good morphologic condition (fig. 3).

It would be unprofitable to attempt to determine just which of the nuclear arrangements of the left side were still functional at the pontile level. In sections through the upper limits of the pons the nuclei pontis were themselves intact, as were the left reticulotegmental and superior central nuclei. Farther caudally a few displaced cells of the nucleus of the mesencephalic root of the left trigeminus were also apparent. About half the cells in the left masticator nucleus were of normal appearance; the rest were pyknotic. The superior olivary nucleus remained intact.

COMMENT

The written record of the present case contains no specific statement as to the rate of the tremor. A check with three of the physicians who saw the patient at times ranging from onset of the disease to termination of its course elicited the unanimous statement that the tremor was of a true alternating type with a rate of from 2 to 3 cycles per second.

It is common clinical knowledge that preexisting abnormal movements are profoundly affected by the appearance of hemiplegia. Parkinson himself observed a case of paralysis agitans in which a stroke appeared and eliminated the tremor, which, however, returned as the patient improved. Gowers[1] stated the situation as follows: "tremor, rhythmical movements and especially irregular movements . . . occur only when there is some return of voluntary power, not when the paralysis remains absolute." This is the current opinion,[2] which is

1. Gowers, W. R.: A Manual of Diseases of the Nervous System, ed. 2, Philadelphia, P. Blakiston's Son & Co., 1895, vol. 2, p. 85.

2. Wilson, S. A. K.: Modern Problems in Neurology, New York, William Wood & Company, 1929, p. 245.

substantially correct, but with which there are difficulties of interpretation. The implications of this view are that the tremor of parkinsonism requires some degree of activity of the corticospinal system and that the pacemaker for the tremor is therefore in the cortex. Now the presence of some degree of voluntary activity does not necessarily mean that the corticospinal projection is partially active, for complete paralysis does not follow severance of this system. The present case clearly indicates that the pacemarker of the alternating tremor is not the supratentorial neuraxis, and the case is, apparently, unique in that the tremor and paralysis developed *pari passu*.

There is a clear indication that as the right side became quite incapable of voluntary activity the tremor, which at first had an intention component, was completely reduced to a static type.

The tumor undoubtedly began in the thalamus (probably the floor of the third ventricle) and must only subsequently have invaded the internal capsule. It is apparent that intention tremor, the initial symptom, must necessarily have been caused by this central lesion. It was as the tumor spread backward toward the cerebellum and involved more tissue that the tremor assumed a static, in addition to its intentional, character. Since the tremor was a phenomenon of the right side, it is apparent that the backward extension of the neoplasm into the left side of the mesencephalon and infringement on the left brachium conjunctivum had nothing to do with the appearance or development of the tremor. It is worth noting that, although a bilateral Babinski phenomenon was reported to be present as early as September 1937 and continued through 1942, there was no evidence of degeneration in the corticospinal projection from the right cerebral hemisphere when the patient died, in 1943.

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JAPANESE B ENCEPHALITIS

Clinical Observations in an Outbreak on Okinawa Shima

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DURING the summer of 1945 an outbreak of encephalitis occurred on Okinawa Shima. At the time, the island was the most important advanced base in the Pacific theater. Large forces of American troops were already assembled for the projected invasion of the home islands of Japan, scheduled for the autumn. It was reasonable to assume that these troops were susceptible to an oriental neurotropic virus disease, and the danger of an epidemic was a matter of great concern to the medical departments of the Army and Navy. When the first civilian patients with encephalitis were reported to the island surgeon, a program for their isolation and study was instituted at once. Within a very short time several groups of investigators were engaged in observing various aspects of the disease and active measures were being taken for its control. Hospital facilities were set up by the Military Government Research Center for the care of civilian patients, and laboratory space was provided for members of Naval Medical Research Unit no. 2 and representatives of the Neurotropic Virus Commission. An active program of vaccination was undertaken with Sabin's formaldehyde-inactivated mouse brain vaccine,[1] prepared in anticipation of an epidemic of Japanese B encephalitis and already stored in medical depots on Okinawa. Mosquito control was intensified, and intensive plane spraying of DDT (2,2 bis (*p*-chlorophenyl)-1,1,1-trichloroethane) over areas of native habitations was initiated within two days after the

This article has been released for publication by the Division of Publications of the Bureau of Medicine and Surgery of the United States Navy. The opinions and views set forth in this article are those of the writers and are not to be considered as reflecting the policies of the Navy Department.

1. Sabin, A. B.; Duffey, C. E.; Warren, J.; Ward, R.; Peck, J. L., and Ruchman, I.: The St. Louis and Japanese B Types of Epidemic Encephalitis: Development of Noninfective Vaccines; Report of Basic Data, J. A. M. A. **122:** 477-486 (June 19) 1943.

first recognition of patients with what was assumed to be an arthropod-borne neurotropic virus infection.

It is the purpose of this report to describe the clinical features of the disease as it occurred among Okinawan natives. Additional data collected by cooperating investigators form the basis for reports on the epidemiology of the disease,[2] serologic reactions,[3] histopathology,[4] studies of possible vectors and reservoirs [5] and other related problems.

Japanese B encephalitis was first identified as a distinct disease after a large outbreak in 1924, when clinical studies [6] made it possible to distinguish it from epidemic encephalitis of type A, i. e., von Economo's disease. Although a form of encephalitis appeared in parts of Japan almost every summer and had been recognized clinically as early as 1871, the epidemic of 1924 spread throughout a fairly wide area and resulted in a mortality of approximately 60 per cent among 6,000 reported cases. The heaviest concentration of infection was in the region of the Inland Sea, an area where the disease has remained endemic. During the period from 1924 to 1937 outbreaks occurred yearly, with especially high incidences in 1924, 1929, 1935 and 1937, resulting in a total of 21,355 reported cases.[7]

Similar recurrent appearances of summer or autumn encephalitis were known to have been reported from the Ryukyu Islands, as well as from Formosa, Manchuria and the far-eastern maritime districts of Soviet Russia. The diseases which occur in these regions are believed to be of virus origin, and a specific agent was first isolated by monkey

2. Mosher, W. E.: Japanese "B" Encephalitis: Epidemiological Report of the 1945 Outbreak on Okinawa, to be published.

3. (*a*) Hodes, H. L.; Thomas, L., and Peck, J. L.: Cause of an Outbreak of Encephalitis Established by Means of Complement Fixation Tests, Proc. Soc. Exper. Biol. & Med. **60**:220-225 (Nov.) 1945. (*b*) Sabin, A. B.: Outbreak of Encephalitis on Okinawa in 1945: Preliminary Report on Status as of August 27, 1945, J. Mil. Med. in Pacific **1**:79-84, 1945; (*c*) Epidemic Encephalitis in Military Personnel: Isolation of Japanese B Virus on Okinawa in 1945, Serologic Diagnosis, Clinical Manifestations, Epidemiologic Aspects and Use of Mouse Brain Vaccine, J. A. M. A. **133**:281-293 (Feb. 1) 1947. (*d*) Hammon, W. McD.: Unpublished data.

4. (*a*) Zimmerman, H. M.: The Pathology of Japanese "B" Encephalitis, Am. J. Path. **22**:965-992 (Sept.) 1946. (*b*) Haymaker, W., and Sabin, A. B.: The Topography of Lesions in the Central Nervous System in a Case of Japanese B Encephalitis on Okinawa, Arch. Neurol. & Psychiat., to be published.

5. Thomas, L., and Peck, J. L.: Results of Inoculating Okinawan Horses with the Virus of Japanese "B" Encephalitis, Proc. Soc. Exper. Biol. & Med. **61**:5-6 (Jan.) 1946. Footnote 3 *b*, *c* and *d*.

6. Kaneko, R., and Aoki, Y.: VIII. Ueber die Encephalitis epidemica in Japan, Ergebn. d. inn. Med. u. Kinderh. **34**:342-456, 1928.

7. Epidemic Encephalitis, Third Report of the William J. Matheson Commission for Encephalitis Research, New York, Columbia University Press, 1939, p. 159.

inoculation with brain material from a fatal Japanese case in 1934. Subsequently, study of the virus was facilitated by the finding in 1935 that the mouse is a susceptible host, and research in laboratories in Russia, Japan and the United States has thrown considerable light on its properties. As in the case of western equine and St. Louis type of encephalitis in the United States, there is good evidence that the virus of the Japanese B type of encephalitis of Japan and the maritime districts is transmitted by mosquitoes.[8] Although sporadic cases occur throughout the year, the disease has a characteristic seasonal recurrence, and the worst outbreaks have appeared during or after periods of hot dry weather.

The first patients with severe encephalitis observed by American physicians in the Ryukyus were seen by Lieut L. M. Miller on Heanza Shima, a small island about 2 miles (3 kilometers) east of Okinawa, on July 8, 1945. Two days later one of us (L. L.) found 4 patients with encephalitis among patients admitted to a large civilian hospital on Okinawa. During the following three months 127 patients were seen by Military Government medical facilities on the two islands, and 66 of the 91 patients found on Okinawa were admitted to the isolation hospital for observation and treatment. The etiologic agent in the disease was first indicated by the results of complement fixation and neutralization tests performed by cooperating investigators, which showed that most of the patients formed specific antibodies against the virus of Japanese B encephalitis during convalescence. An infectious agent, identified as the virus, was subsequently isolated from brain tissue of a patient who died on the fifth day of illness.[3a-c]

CLINICAL OBSERVATIONS

Age and Sex Distributions.—Of the 66 hospital patients, only 2 were over 30 years of age,[9] 1, a man aged 36, and the other, a woman aged 51. The highest incidence was in the age groups of 5 to 9 (28 patients) and 12 to 16 years (22 patients). There was 1 infant under 2 years of age (actual age, 6 months), and 4 others were under 5 years of age.

8. Mitamura, T.; Kitaoka, M.; Watanabe, S.; Hosoi, T.; Tenjin, S.; Seki, O.; Nagahata, K.; Jo, K., and Shimizu, M.: Weitere Untersuchungen über die Uebertragung der japanischen epidemischen Enzephalitis durch Mücken, Tr. Soc. path. jap. **29**:92-105, 1939. Petrischeva, P. A., and Shubladse, A. K.: The Vectors of the Autumn Encephalitis in the Maritime District, Arkh. biol. nauk. **59**: 72-77, 1940. Smorodintzeff, A. A.; Newstroev, V. D., and Chagin, K.: Zur Aetiologie der herbstlichen Enzephalitisausbrüche, J. Mikrobiol., Epidemiol. u. Immunobiol., 1941, no. 2, pp. 3-15.

9. Ages given throughout this report are estimated according to Okinawan custom, which considers the newborn infant 1 year of age, the 1 year old child 2 years of age, and so on. During the first year of life a child is referred to as being less than 2 years old.

The greater prevalence of the disease among the young confirmed previously reported observations in Ryukyu epidemics of encephalitis [10] and agreed with the experience of Okinawan physicians whom we interviewed.

According to the epidemiologist's figures on all the native patients,[2] males and females were almost equally affected. In the hospital group there were 38 females and 28 males.

Onset of Illness.—It was frequently difficult to obtain a history, since many of the patients were admitted in stupor or coma, frequently unaccompanied by competent informants. However, some information was eventually obtained on all but 2 patients, and the histories of 42 were considered satisfactory sources of clinical data. The onset of illness was described as acute and abrupt in 38 of the 42 patients. There was no instance of gradual development of characteristic symptoms,

TABLE 1.—*Symptoms According to the History* *

	No. of Patients	Percentage of 42 Histories
Fever	39	93
Headache	35	83
Stupor or coma	31	74
Convulsions	16	38
Personality change	15	36
Speech disability	15	36
Nausea and vomiting	7	17
Diarrhea	4	10
Vertigo	3	7
Chills	2	5

* Based on 42 histories considered adequate.

although there were a few histories of antecedent fever or diarrhea of variable duration. Generally, the patient complained of severe headache accompanied with fever and was disabled within a few hours. Children were described as having onset of symptoms while playing, returning to their homes with severe headache and taking to bed at once. Women who had been working in the fields gave similar stories.

Symptomatology.—The frequency with which various symptoms occurred in the 42 patients with adequate histories is indicated in table 1.

Fever and headache were the most common symptoms. About three fourths of the patients were admitted with a history of severe disturbances of consciousness, and others became drowsy, stuporous or comatose during the period of observation. A history of convulsions was obtained for 16 of the patients with adequate histories, and convulsions were observed in the hospital or recorded in the histories of 22 of the 66 patients. Determination of personality changes was difficult because of the language barrier, but obvious abnormality was evident

10. Footnote 7, p. 164.

to members of the patient's family in 36 per cent of the patients. Disturbance or absence of speech before the onset of stupor or coma was noted in a similar number. Gastrointestinal symptoms were not strikingly frequent. However, nausea, vomiting and diarrhea occurred often enough to indicate a true association with the disease. Diplopia was infrequent, and a clearcut history of its recognition was obtainable for only 1 patient. Vertigo was not common. Chills were reported in only 2 instances.

Physical Findings.—The acute manifestations of this disease were predominantly those ascribed to meningeal irritation, namely, stiffness of the neck and back and limitation of flexion of the lower extremity on the trunk. Early, however, signs of diffuse involvement of the

TABLE 2.—*Observations on Initial Physical Examination*

Physical Findings	No. of Patients	Percentage
Mental status		
Coma	16	25
Stupor	16	25
Drowsiness; lethargy	12	18
Apathy	8	12
Restlessness or delirium	6	9
Alertness	7	11
Stiff neck	48	74
Kernig sign	41	63
Abnormal abdominal reflexes	41	63
Aphasia	30	46
Pathologic reflexes	28	43
Deep reflexes		
Unequality	24	37
Absence or weakness	19	29
Hyperactivity	6	9
Pupillary disturbance	17	26
Disturbance of extraocular muscles	16	25
Focal weakness	14	22
Rigidity	10	15
Tremor	8	12
Athetosis	1	

nervous system were notable, and some of the patients presented not only stiffness but weakness of the neck, orthotonos, apparent trismus, alterations of consciousness varying from lethargy to deep coma, mental disturbances, reflex abnormalities, paralyses, tremors, convulsions, nystagmus, oculomotor dissociation, athetosis, loss of muscle tone, distention of the bladder and incontinence of urine. True motor aphasia was a concomitant of right hemiplegia, but transient loss of power of speech without accompanying paralysis was often noted. Table 2 indicates the frequency of certain common signs observed on initial physical examination of 65 of the 66 hospitalized patients.[11] Since patients were admitted to the hospital from the first to the twenty-second day following onset of the disease, the data are not indicative of physical findings at comparable stages of the disease. However, they serve to emphasize the variability of the clinical picture as it presented itself to the observers.

11. One record was lost.

Fifty-eight patients, or 89 per cent of those examined, showed disturbed consciousness on admission; only 7 were alert and communicative. Nuchal rigidity was present in 74 per cent of the patients, often associated with stiffness of the back and pain on attempted or passive motion. Stiffness of the neck was most prominent in anteroflexion, but lateral motion was also restricted at times. Kernig's sign was present in 63 per cent of the patients. Tenderness of muscles or nerve trunks was not observed, and sensory examination showed a normal status in those able to cooperate for testing.

Reflex disturbances of all kinds were observed on initial examination, as well as during the course of the illness. In general, suppression of reflexes seemed characteristic of the early phase: About one third of the patients admitted within five days of the onset of symptoms had weakness or absence of tendon reflexes, and in two thirds the abdominal reflexes could not be elicited. Thereafter considerable alteration of reaction was seen from day to day, with a tendency toward spasticity manifested by hemiplegic patients and loss of reflexes by those with progressive deterioration. Pathologic plantar reflexes were present in 43 per cent of the patients on first examination.

The 30 patients listed as having aphasia were those who seemed to have some speech disability other than that due to disturbances of consciousness alone. In some instances several days elapsed after clearing of the sensorium before voluntary speech returned. Typical motor aphasia was seen only with right hemiplegia and was permanent in 1 instance.

Abnormalities of the extraocular muscles noted included strabismus; nystagmus, which was present in 7 patients, and dissociated movements, which were observed in 5 patients. Dissociation was characterized by independent rotation or nystagmus, drifting into extreme divergence, and transient convergence. The frequency of changes in the pupillary reflexes is probably understated, since observation of the deeply pigmented irises was difficult in the bright ward. However, early in the illness the pupils were frequently contracted and fixed to light.

Fourteen patients had weakness of the extremities or the facial muscles, varying from minor paresis to hemiplegia, paraplegia or quadriplegia. Rigidity of varying degree was fairly common: Four patients had trismus and 2 opisthotonos, and in many rigidity was limited to one or more extremities during the early part of the illness. Eight patients showed some form of tremor on admission. Typical athetosis was observed in only 1 patient, but athetoid positions were not uncommon, especially in paralytic extremities. Excessive salivation was observed in 4 patients, all of whom showed evidence of widespread permanent damage to the central nervous system.

COURSE OF THE DISEASE

Duration of Illness.—The shortest interval in which improvement in clinical status was noted was three days; the longest, forty-one days. The duration of illness was extremely variable. However, of the 48 patients who improved after the acute phase, 36 were better within three weeks of onset. Of the 35 patients who finally recovered, 2 were well within nine days and 15 within twenty days of onset. Twelve patients were ill for more than one month, and the longest illness with recovery was fifty-seven days.

Thirteen deaths occurred in the hospitalized group of 66 patients. Nine of the 13 patients died within fifteen days of onset; the others died after thirty-eight, forty-one, forty-eight and fifty-two days of illness, respectively.

Fever.—Of the 29 patients admitted within five days of the onset of illness, 20 were febrile; the temperature curves of 19 were irregular or spiking, and the temperature of 1 was persistently elevated. The duration of fever due to encephalitis per se was difficult to estimate because of a fairly high frequency of complications. However, when 1 patient who had widespread tuberculosis in addition to encephalitis is excluded, the febrile period lasted from three to thirty-two days from the onset of illness. Only 17 patients whose temperature records were adequate were free from complications such as pneumonia, otitis media or cutaneous abscesses. For these patients the febrile period was variable, but for 10 it lasted a week or less. The 4 patients with severe degenerative manifestations who died on the thirty-eighth to the fifty-second day of the disease had elevated temperatures throughout their illnesses, but each of them had some infectious disturbance other than encephalitis—tuberculosis, pneumonia or extreme decubitus ulceration.

Variations in Course.—Although the onset of symptoms was always acute, the course of the disease was sometimes subacute or chronic. Seventeen patients recovered completely after a brief illness, usually lasting less than two weeks. Four without complications, as well as 5 patients with encephalitis and pneumonia, died within fifteen days. The remaining 39 patients had protracted illnesses. Of these, 18 patients made satisfactory recoveries, while 17 showed residual signs of damage to the central nervous system; 4 died after progressive deterioration.

Paralysis.—Twenty-three patients exhibited transient or persistent paralyses. Monoplegia or diplegia was present for one or more days in 5 patients; 2 showed transient facial weakness. Hemiplegia on the right, with complete recovery, was observed in 5 patients and hemiplegia on the left in 1 patient. Two patients had complete hemiplegia on the right with aphasia: One recovered speech and had only residual spastic weakness of the right upper extremity; the other retained a spastic

gait and paralysis of the upper extremity as well as complete motor aphasia (case 4). Two patients were paralyzed in all four extremities until death; the paralysis gradually shifted from the flaccid to the spastic type and was at times of different character in the upper and in the lower extremities. One patient had muscular wasting and showed a characteristic dystrophic type of weakness; ultimately there was full recovery except for the right arm, which remained weak and lacked synergic swing with walking. Another patient survived with moderate deformity of the extremities, quadriplegia and mental deterioration (case 5). Four patients showed progressive weakness, wasting and contracture, until at death there was pronounced deformity as well as paralysis of the extremities. Although the deformity was not identical in all 4 patients, there were certain common characteristics: The upper extremities tended to rotate progressively inward until the dorsa of the hands came into contact with the lateral surfaces of the thighs; the elbows

TABLE 3.—*Incidence of Paralyses*

	Total No. of Patients
Transient monoplegia or diplegia	5
Transient facial weakness	2
Transient hemiplegia	6
Hemiplegia—persistent paresis	2
Persistent quadriplegia	2 (fatal)
Dystrophic weakness	1
Paralysis with contractures	5 (4 fatal)
Total	23

were usually extended, the wrists and fingers sharply flexed and the thumbs placed between the fingers. Rigidity and fixation of the deformity gradually increased but was not equal bilaterally. Simultaneously, one or both feet exhibited marked equinus, inversion and planter flexion of the toes, to form the rigid, talon-like arc of the so-called striatal foot. The number of patients with the paralytic manifestations described is shown in table 3.

Disturbances of Consciousness.—Almost every patient in the early stage showed disturbed states of consciousness, varying from apathy to deep coma and two thirds of the patients had a history of stupor or coma. The duration of stupor or coma was six days or less in 24 patients, but 1 patient was comatose for fifty days and another for forty days. Three patients who were comatose for thirty-four, forty and fifty days, respectively, failed to recover.

Tremor.—Tremor was of infrequent occurrence and was more common during the early period of the illness. Twelve patients exhibited tremor at some time in the course of their disease. There was no characteristic pattern, and most of the tremors were bizarre: irregular,

coarse and convulsive, occasionally involving many muscle groups (case 6). At the time of discharge from the hospital only 2 patients exhibited appreciable tremor. One had a tremor of the hands somewhat suggestive of the pill-rolling type and a slight nodding of the head. Both tremors were of only slight degree when the patient left the hospital, two months after onset of illness. In another patient head nodding developed as an acute manifestation on the thirty-fourth day of illness, associated with other symptoms of relapse. Vertical or lateral nodding was periodically present at final observation, on the fifty-ninth day after onset of illness.

Convulsions.—In addition to convulsive twitching involving focal areas, such as an upper extremity and the shoulder girdle, or both extremities in a hemiparetic patient, some patients had typical epileptiform convulsions, with deviation of the head and eyes to one side, clonic

TABLE 4.—*Complications in Course of Illness*

Complications or Coexistent Disease	No. Survived	No. Who Died	Total No.	Per Cent of 65 Patients with the Disease
Pneumonia or pneumonitis	9	7	16	25
Intestinal helminthiasis	23	10	33	51 *
Otitis media	12	1	13	20
Corneal ulcer	3	0	3	4.6
Malaria	4	0	4	6
Decubitus ulcer	3	4	7	11
Tuberculosis	..	1	1	
Cystitis and pyelitis	1	1	2	
Abscesses of the teeth	1	0	1	
Snake bite	1	0	1	
Cysticercosis	0	1	1	
Herpes zoster	1	0	1	

* Forty-three stools examined—30, or 70 per cent, positive.

movements of the extremities—usually more pronounced on one side—and rigidity of the trunk. Serial convulsions were occasionally present. There did not appear to be any relation between the occurrence of convulsions and the ultimate outcome of the illness.

Complications.—The coincidental disease processes which were observed (table 4) may be differentiated into those which were important factors in causing morbidity or death and those which were of little prognostic significance. Of the former, pneumonia and pneumonitis were common, having occurred in 16 patients, including 7 in whom the presence of the complication was confirmed at autopsy.[12] Intercurrent malaria was a less serious problem and did not affect the mortality rate.

12. Seven of the patients who died had pneumonia; 5 died after relatively acute and 2 after protracted illnesses. The view expressed about the North American encephalitis,[22] that deaths occurring after the third or fourth day are almost invariably due to complications, does not seem to hold here. Four patients who died after seven days of illness failed to show evidences of disease other than that of the central nervous system.

Miliary tuberculosis was discovered post mortem in a patient who died fifty-two days after the onset of encephalitis.[13] Malnutrition was common and was a difficult problem of management during the lethargic phase of the illness.

Of the purely incidental conditions, helminthiasis was by far the most frequent: Ova or larvae were observed in the stools of 51 per cent of patients and infection, frequently multiple, was noted in 77 per cent at autopsy. Other abnormalities are indicated in table 4.

SEROLOGIC STUDIES

Early and convalescent specimens of blood were obtained from 25 patients by Thomas and Peck.[14] Complement fixation tests performed at the Guam laboratories of Naval Medical Research Unit no. 2 according to the technic of Casals [15] showed a fourfold or greater increase of titer in 22. The serums of 2 patients gave negative reactions, and the serum of 1 patient showed complement fixation in a dilution of 1:8 with both early and convalescent specimens. Accordingly, there was serologic confirmation of the clinical diagnosis in 88 per cent of this series of patients. Neutralization tests were not performed.

Hammon [3d] also collected specimens of blood from 22 patients, but only during the convalescent phase. Complement fixation tests were performed on these, with the following results: Six were anticomplementary; 3 gave negative reactions and 13 positive reactions. A positive reaction in the virus neutralization test, which was considered indicative of infection with Japanese B encephalitis virus at some time during the patient's life, was obtained for 14 patients; 4 tests gave doubtful results; 4 showed no antibody. In the absence of specimens obtained during the acute phase the results of the neutralization tests are of little diagnostic significance. However, of 14 serums on which both neutralization and complement fixation tests were performed, the results were positive in both tests in 7, positive in 1 and doubtful in the other in 3, negative in both tests in 2, negative in the complement fixation test but positive in the virus neutralization test in 1 and the reverse in 1. These serums were also tested for neutralizing antibody against the viruses of the St. Louis and western equine types of encephalitis, with only 1 doubtful result in each of the two series of tests. These findings furnish additional serologic evidence of the nature of the virus in the Okinawa outbreak and suggest a fair correlation between the results of the two serologic tests during convalescence.

13. There was no tuberculous involvement of the central nervous system. Gross and histologic changes were typical of encephalitis.

14. Thomas, L., and Peck, J. L.: Unpublished data.

15. Casals, J., and Palacios, R.: The Complement Fixation Test in the Diagnosis of Virus Infections of the Central Nervous System, J. Exper. Med. **74**:409-426 (Nov.) 1941.

STUDIES OF THE SPINAL FLUID

Equipment for chemical study of the spinal fluid was available for only part of this study, and the difficulty of transporting specimens to other medical facilities precluded a complete set of serial observations. The cerebrospinal fluid pressure was not recorded, and no statement can be made except the general remark that pressure seemed elevated early in the disease and was obviously elevated in 1 infant with an open anterior fontanel. Cytologic findings were extremely variable even early in the illness. In 9 the first specimen of spinal fluid failed to show the presence of leukocytes, and 7 others had only 6 cells or less per cubic millimeter. In most instances, however, there was definite pleocytosis, the count varying from 9 to 955 cells per cubic millimeter. Counts of 250 to 955 cells were noted most frequently before the fifth day of the disease. Even early in the illness there was usually a preponderance of lymphocytes. Only 6 patients had fewer than 50 per cent of lymphocytes during the first fifteen days; during the same period 20 patients had between 90 and 100 per cent lymphocytes.

Subsequent specimens of spinal fluid generally showed a diminishing pleocytosis. There was no instance of a cell count of over 25 per cubic millimeter after the twentieth day of illness. The type of cell, however, in the second and in later specimens of spinal fluid was usually over 75 per cent monocytic.

Qualitative tests for globulin (Pandy) tended to become more frequently positive during the course of the first three weeks of illness. Eighteen of 45 recorded tests on the initial specimen of spinal fluid were reported as positive, while 23 of 44 subsequent specimens were so reported. Total protein, estimated by the tyrosine colorimetric method, ranged from 18.5 to 85.2 mg. per hundred cubic centimeters in 16 initial examinations of the spinal fluid. Eleven values were above the extreme upper limit for the method, namely, 50 mg. per hundred cubic centimeters. Within the first five days after onset of illness 6 fluids showed an excess of total protein, while 4 were within the limits of normal.

Most of the results in 16 initial quantitative estimations of sugar fell within the extreme range of normal for the method, i. e., 50 to 75 mg. per hundred cubic centimeters. Three values were below 50 mg., and 2 above 75 mg., per hundred cubic centimeters. However, 6 values were above the normal range of 60 to 65 mg. per hundred cubic centimeters, and 3 were below, in speciments obtained during the first ten days of illness.

Reexamination of the spinal fluid after the fifteenth day of illness showed rather consistently elevated total protein levels and generally normal values for sugar. In 12 of 21 protein determinations, the results were above 50 mg., and in 3 others between 46 and 50 mg., per hundred cubic centimeters. In 4 instances the protein level was above 75 mg. per

hundred cubic centimeters. In 3 determinations, the sugar level was below 50 mg., in 18 within the range of 50 to 75 mg. and in 4 above 75 mg., per hundred cubic centimeters, between the fifteenth and the fifty-second day of illness. Twenty-six fluids examined for sugar during that interval were reported as follow: Within the strictly normal range of 60 to 65 mg. per hundred cubic centimeters, 4; below 60 mg., 10; above 65 mg., 12. In 4 of the last the value exceeded 85 mg. per hundred cubic centimeters.

HEMATOLOGIC FEATURES

Evaluation of hematologic observations is limited to 26 of the first 58 patients admitted during July and August, who were intensively studied by the hematologist (J. W. N.). The cases selected were those without complicating infections other than helminthiasis. Five patients were seen early in the disease: 2 on the second day and 3 on the third. The composite findings showed an early leukocytosis, with a count of 15,000 to 25,000 and an increase in neutrophils. After the initial elevation the white blood cell count fell below 10,000 before the eighth day in 7 patients. In 7 other patients it remained slightly above 10,000 between the eighth and the fifteenth day of the disease. Only in cases complicated by pneumonia or otitis media was the white cell count elevated after the fifteenth day.

Early in the disease there was a relative and an absolute increase in the neutrophilic cells with a shift to the left and a moderate degree of toxicity, whereas the other white blood cell elements were all strongly depressed. As the acute phase of the disease subsided, these cells returned and the differential count assumed a normal pattern. The eosinophilia normally seen in a high percentage of Okinawan children became evident again in the early stages of improvement. In cases of neurologic relapse or when pneumonia or otitis media complicated the clinical status, the white blood cell count and differential pattern reverted to those changes seen early in the disease.

As improvement took place the lymphocytes at times showed extreme youth and toxicity whereas at others there was no abnormality. There was no characteristic lymphocytic change.

A slight degree of anemia was common, as was to have been anticipated in a population with widespread helminthiasis, subsisting on a diet inadequate in protein and iron. In this group of uncomplicated cases the average red blood cell count was 4,260,000 and the average hemoglobin content was 11.4 Gm. per hundred cubic centimeters (Hellige or copper sulfate specific gravity method).

PSYCHIATRIC OBSERVATIONS

Language barriers made it difficult to evaluate the mental status accurately, and many minor alterations undoubtedly escaped observa-

tion. Among the obviously disturbed patients, there were 10 who showed a high degree of irritability early in the illness and 1 with similar manifestations after apparent convalescence. Eight patients were confused and 5 were apathetic during the early phase. Three exhibited unusual emotional instability characterized by crying, spontaneous laughter and shifting mood. Two were depressed and 3 had frank transient psychoses. In only 2 patients were prolonged severe psychoses observed. The mental state of 1 patient cleared completely except for slight mental retardation several weeks after transfer to the psychiatric ward of a Military Government hospital; the other showed a late tendency toward clearing but was discharged after nearly three months of illness with persistent reactions indicative of organic deterioration (case 7). Mental retardation of varying degree was believed to be present in 13 patients at the time of discharge from the hospital. One of the 5 patients with chronic course and extreme mental deterioration survived as a deformed idiot (case 5).

The high incidence of mental retardation may be spurious, since it is possible that prolonged follow-up observation would have shown considerable improvement in some patients. However, final observation very often revealed sluggishness of response and apparent clouding of the sensorium in patients otherwise fully recovered. One patient who failed to show any tendency toward recovery of interest and physical activity following his acute phase continued to present symptoms of general deterioration, apathy, fixed facies and muscular wasting throughout approximately ten weeks of observation in the hospital and at home.

MORTALITY AND SEQUELAE

The over-all mortality among patients on Okinawa Shima was 28.6 per cent. In the hospital group of 66 patients the mortality was 19.7 per cent. These figures are at variance with reports [7] of 49.6 to 75.2 per cent in Japanese epidemics (1924 to 1937), although a mortality of 25 to 30 per cent was reported for the age group under 20 in the prefecture of Tokyo in 1935. In general, the mortality rate in Japanese outbreaks has been lower in the younger age groups, and the high percentage of survival in the Okinawa group may be due to the relative youth of the patients.

According to results in this outbreak, about one fourth of the total number of patients and about one third of the survivors had clinical evidence of mental impairment, personality change or disturbed motor function at the time of discharge from the hospital. Allowing for the possibility of further improvement, it is estimated that one fifth of the total series, or one fourth of the survivors, will have suffered permanent damage of varying degree as a result of the disease. Among the serious results to be anticipated, on the basis of information available from this

outbreak and from the review of cases of known postencephalitis, are hemiplegia, hemiparesis, aphasia, cerebellar syndromes, modified paralysis agitans, mental impairment, organic psychotic states and idiocy associated with extreme deformity and paralysis.

PATHOLOGIC STUDY

Pathologic material from most of the 13 cases with autopsy forms the basis for a detailed report on the histologic alterations of the central nervous system in this disease, prepared by Comdr. H. M. Zimmerman.[4a] The observations in fatal cases described later in this report will indicate the type of changes noted in cases of the acute as well as of the late stages. However, the gross and histologic changes may be briefly summarized as follows:

During the first two weeks the brains in fatal cases showed little distinctive gross abnormality. Injection of pial vessels was noted in every case, and this was associated with flattening of convolutions and apparent swelling of the cerebrum. On section, the intrinsic vessels were prominent and in some cases suggested minute petechiae. Pronounced injection of the vessels of the basal ganglia was seen in 1 patient. The left globus pallidus appeared somewhat softened at the eighth day in 1 brain. At the fifteenth day, the cerebrum of another showed the first clearcut cortical changes. The brain was soft, and the gray matter exhibited focal areas of gelatinous appearance on cut section.

The 4 brains examined from the thirty-eighth to the fifty-second day of the disease showed striking changes. In 1 instance (case 6) a very incomplete gross examination was made of the fresh specimen in order to preserve an almost intact organ for detailed histologic study. However, in all these 4 brains, softening, varying from early injection, accompanied with slight change in substance, to frank cystic degeneration was observed in the substantia nigra or in other nuclear structures of the pons or the midbrain; softening with pallor was present in focal areas in the cerebral cortex, and the cerebellar folia showed loss of gray matter or pallor. Flattening of convolutions was no longer present, but definite focal atrophy with external hydrocephalus of slight degree was observed in each case. The aqueduct was invariably dilated, and the ventricular system showed evidence of early internal hydrocephalus.

In 5 brains in cases of the acute stage examined histologically, Zimmerman reported widespread changes in the ganglion cells, most severe in the cerebellar cortex (fig. 1 *A*) and least marked in the medulla and cord, but involving the cerebral cortex, basal ganglia, cornu ammonis and substantia nigra. The leptomeninges showed mild infiltration by lymphocytes. Perivascular cuffing with lymphocytes, and occasionally monocytes and macrophages (fig. 1 *B*), was present in many different areas, including white matter which was otherwise free from lesions.

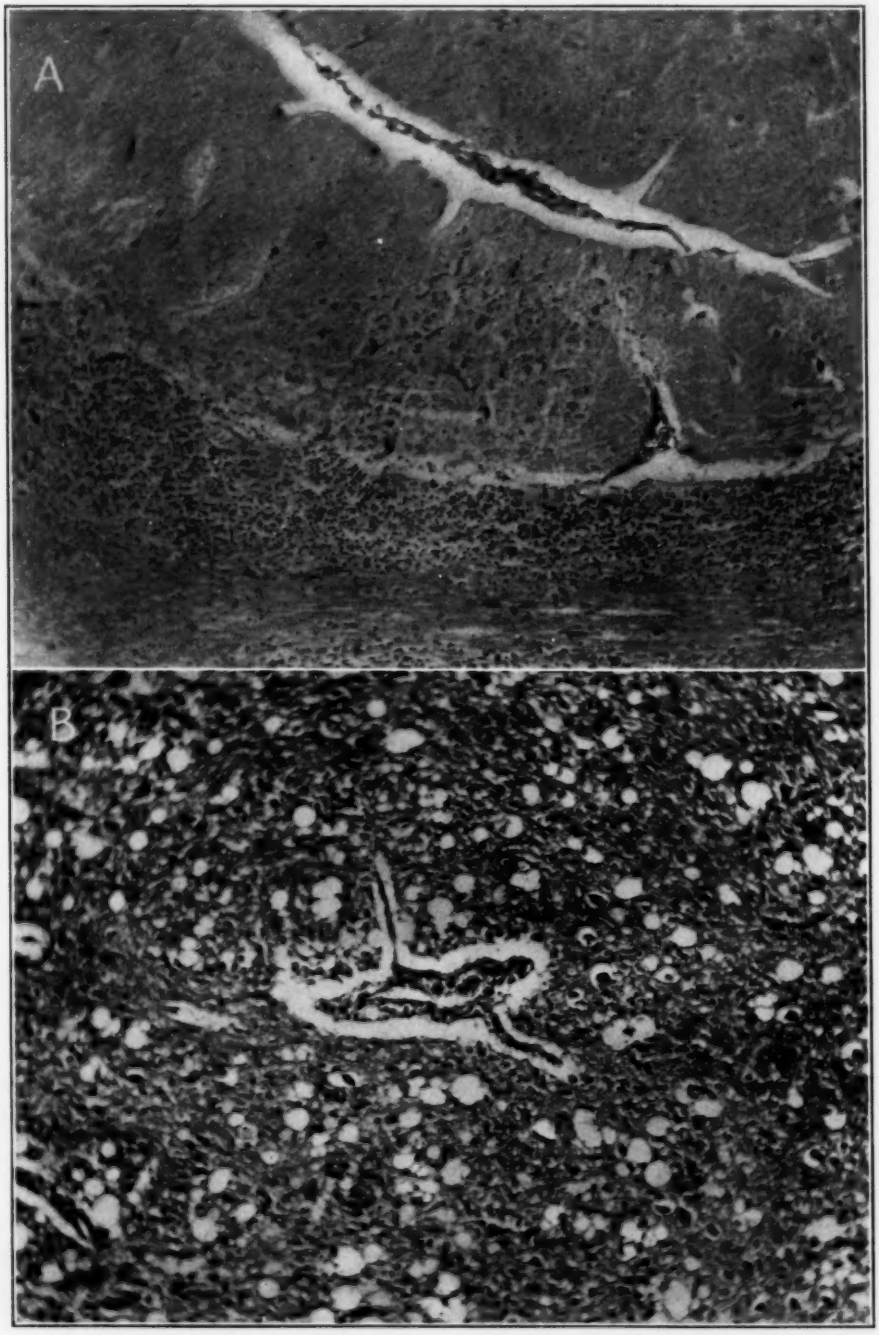

Fig. 1.—*A*, cerebellum, eighth day of disease, showing loss of Purkinje cells and focal glial proliferation in the molecular layer. *B*, midbrain, in a more advanced stage of the disease, showing perivascular infiltration and loose fibrillary stroma containing few ganglion cells; × 8.

Hemorrhages were noted in Virchow-Robin spaces, and also sometimes overrunning the bounds of the perivascular sheaths and lying in the nerve parenchyma. The affected ganglion cells showed varying degrees of disintegration, from eosinophilia to complete destruction. Early leukocytic infiltration about injured cells was followed by microglial proliferation, and after destruction of ganglion cells fat-laden macrophages were in evidence. Sponginess of the interstitium in early lesions was followed by astrocytic proliferation, forerunner of the gliosis seen in later specimens. The lesions of the cerebellar cortex involved principally the Purkinje cells and their dendritic processes.

The brain of a patient who died on the fifth day of illness showed numerous discrete lesions involving various laminas of the cerebral cortex which had a strong resemblance to the "plaques" of multiple sclerosis. Often these "plaques" were infiltrated by leukocytes and gave the appearance of miliary abscesses. This specimen also showed comparable lesions of the basal ganglia, destruction of ganglion cells in pontile nuclei and involvement of cranial nerve nuclei of the medulla, as well as the inferior olives, suggestive of poliomyelitis. The cerebellar cortex showed grossly visible punched-out, spongy plaques of the molecular and Purkinje cell layers, in which the large ganglion cells were severely damaged or had entirely disappeared. In the cervical portion of the spinal cord there were areas of lymphocytic infiltration, edema and neuronal injury of the anterior and posterior cornua which were also suggestive of acute poliomyelitis.

The histopathologic observations in an early fatal case and in a case of death after forty-one days of illness are presented later (cases 2 and 6).

Associated visceral pathologic processes in the necropsy material, aside from pneumonia, were not clearly related to encephalitis. Pneumonia was found in 7 cases in the gross examination and was reported in an additional case after histologic examination. In 2 cases there was insufficient histopathologic evidence to support a diagnosis of encephalitis, and it is possible that pneumonia was not only the cause of death but also the basis for meningismus. However, the cerebrospinal fluid showed pleocytosis in 1 case; and both were clinically typical of the disease and therefore included in this series, although with considerable reservation. It is interesting to note that pneumonia was present in all but 2 cases which terminated within fifteen days but was found in only 2 of the 4 cases in which death occurred after thirty-eight days, and in 1 of these it was associated with miliary tuberculosis. The lesion in the early cases was usually bronchopneumonic, and not the interstitial variety associated with virus infections. The possibility, however, that pulmonary involvement is an intrinsic part of the early phase of infection is worthy of further investigation.

Primary healed tuberculosis was observed in 2 cases, disseminated tuberculosis in 1 case, chronic nephritis in 1 case, cysticercosis of the brain, lungs and epicardium in 1 case, and mesenteric adenitis was prominent in 5 cases. Other incidental observations were cystic ovaries, in 2 cases; hepatomegaly and splenomegaly, in 1 case each, and hydrops of the gallbladder due to obstruction of the cystic duct by a dead ascaris, in 1 case. Decubitus ulceration was extreme in 3 of the 4 cases of the chronic form. Intestinal worms were found in the gastrointestinal tract in 9 of the 13 cases in which it was examined.

DIAGNOSIS

Encephalitis due to the virus designated as the Japanese B type cannot be diagnosed without resort to special serologic and virologic tests. The disease may be suspected and the diagnosis may be entertained on clinical grounds when in known endemic or epidemic areas patients with sudden onset of fever and headache exhibit progressive signs of meningeal irritation, followed by evidences of diffuse disease of the central nervous system. Recognition of the syndrome is not always easy, and the clinical status varies not only from case to case, but often at short intervals in the same case. Quite characteristically during the first few days of illness there are pupillary miosis with impairment of reaction to light, suppression of abdominal reflexes, diminution or inequality of deep reflexes, focal weakness of facial muscles or of one or more extremities, disturbance of consciousness varying from apathy to deep coma, restlessness, confusion, orthotonos, nuchal stiffness and weakness, a positive Kernig sign and, frequently, convulsive episodes. During epidemics the disease may be suspected in patients with only nuchal rigidity and a positive Kernig sign. Pathologic plantar reflexes are frequently elicited, but the reflex findings in general are variable and abnormalities are often fleeting.

The white blood cell count is elevated, and the neutrophils show an increase in number, as well as relative immaturity. Toxic changes are fairly prominent during the acute phase of the illness. Within ten to fifteen days the leukocytosis usually subsides unless there is a complicating infection.

Examination of the cerebrospinal fluid is often of assistance in making the diagnosis, since moderate pleocytosis with initial moderate and later marked lymphocytic preponderance is usually found. The absence of an unusual number of cells does not, however, preclude the diagnosis. Chemical examination of the fluid, particularly the protein and sugar contents, is important in excluding other conditions: In Japanese B encephalitis the protein level may be slightly elevated, and after the first few days the sugar may be slightly higher than normal, though in general deviation from the normal is slight in degree; in tuberculous

meningitis, on the other hand, marked depression of sugar and elevation of protein are highly characteristic.

The diagnosis is established with certainty by isolation of the specific virus and identification by appropriate serologic tests. Although detection of the virus in the blood and the spinal fluid has been reported, attempts to infect mice inoculated with 17 specimens of blood and 16 specimens of spinal fluid obtained during the acute phase of the disease in this group of patients gave negative results.[16] Fresh brain tissue from a case of the early acute stage was the source of successful mouse inoculation with a virus which was serologically identified as that of Japanese B encephalitis.[17]

Experience with the complement fixation method of Casals and Palacios,[15] reported by Hodes, Thomas and Peck,[3a] and work in progress in other laboratories [3b-d] indicate that this test is of value in determining whether the Japanese B virus is responsible for a particular outbreak, and there is reason to anticipate that early diagnosis may also be facilitated in individual cases. Neutralization of specific virus by convalescent serum is an important diagnostic aid; however, as in the case of the complement fixation test, it is necessary to obtain blood at successive intervals in order to demonstrate a rising titer of neutralizing antibodies. In Okinawa a large percentage of bloods from the normal adult population possess neutralizing power of significant degree,[18] but complement-fixing antibodies are rarely encountered. [3c,d]

Forty-four patients were admitted to the hospital suspected of having encephalitis but were found to have other conditions causing neurologic manifestations. Tuberculous meningitis was unusually common; the clinical diagnosis was confirmed by autopsy in 8 cases. Malaria, although always of the benign tertian type, was often found to be the cause of symptoms simulating encephalitis. Other conditions encountered were meningococcic meningitis, poliomyelitis, meningismus from pneumonia, subdural or intracranial hemorrhage, brain abscess, brain tumor, shrapnel injury of the brain, cerebral emboli from bacterial endocarditis and epilepsy. In most instances the differential diagnosis was established clinically.

A condition not encountered but frequently suspected, especially early in this study, was tetanus. Several patients had well marked trismus associated with orthotonos when seen by the physician; and, especially because of the high incidence of tetanus among Okinawan civilians injured during the siege of the island, the diagnosis of tetanus was seriously considered. In fact, several patients were admitted with a history of having received one or more injections of tetanus anti-

16. Thomas, L.: Personal communication to the authors.
17. Sabin, A. B.: Personal communication to the authors. Thomas.[16] Sabin.[3b,c]
18. Thomas.[16] Sabin.[3c,d]

toxin. Even though injury was not always identifiable, there was usually sufficient scarification from wet cupping or moxacautery to serve as a portal of entry for the tetanus bacillus. The diagnosis was fairly easily ruled out, however, by the presence of high fever, the demonstration that trismus was not fixed, as in tetanus, and the usually prominent evidences of disorder of the central nervous system. Most patients with tetanus were mentally clear early in the illness, whereas disturbance of consciousness was almost the rule in patients with encephalitis.

REPORTS OF CASES

The following case summaries are presented to illustrate the principal clinical varieties of the disease which were observed.

CASE 1.—Acute encephalitis with early recovery.

A 3 year old Okinawan girl, admitted to the hospital on Aug. 11, 1945, had complained of a slight cold and nasal discharge for one week. On August 10 she suddenly had a headache and felt feverish. She became comatose during the night and exhibited constant twitching movements of the right side of the body. On the morning of admission she had a temperature of 101 F.

Physically, the child was well nourished but acutely ill and exhibited continuous clonic convulsive movements of the right arm and leg. Examination at another hospital earlier in the day had shown paralysis of the right side of the body, deviation of the eyes toward the right, absence of reflexes and inability to swallow. There was left internal strabismus; reflexes were not elicited on the right, and only weak triceps and patellar reflexes were present on the left. Abdominal reflexes were absent on the right but normal on the left. There were no pathologic plantar reactions. There was no stiffness of the neck or restriction of flexion of the thigh.

Examination of the spinal fluid revealed 16 lymphocytes per cubic millimeter. On the day of admission the blood count showed 3,790,000 erythrocytes and 23,150 leukocytes per cubic millimeter, with a differential count of 86 polymorphonuclear leukocytes, 3 of which were immature, 8 lymphocytes and 6 per cent monocytes. A total plasma protein of 7.8 Gm. per hundred cubic centimeters and a derived hematocrit level of 36.5 were determined by the copper sulfate falling drop method. The leukocyte count was 18,450 on August 12, 12,400 on August 13, 18,850 on August 14, 12,700 on August 15, 10,100 on August 16, 6,900 on August 18, 11,700 on August 21 and 11,350 on August 26. The differential count showed a gradual diminution of granulocytes and less evidence of toxicity. On August 25 there were 57 polymorphonuclear leukocytes, with only 1 band form, 39 lymphocytes, 2 monocytes and 3 per cent eosinophils. On August 14 the spinal fluid was slightly bloody, but the hemolyzed specimen showed 18 leukocyes, 56 per cent of which were lymphocytes; the globulin was slightly increased, and the sugar was 75 mg. per hundred cubic centimeters. Hookworm ova were present in the feces.

Convulsions continued to occur throughout the first two days of the illness, after which there was transient paralysis of the right arm and leg, lasting only a day. By the third day in the hospital the child was no longer comatose but was extremely irritable and resistant. Internal strabismus was observed for a few days, but this cleared completely. Weakness of the right arm was noted a few days after apparent recovery from paralysis, but this also subsided in a short

time. By the twelfth day after onset of the disease the patient was up and about, active and alert, and had apparently made a fairly complete recovery. Dr. Hammon reported that a specimen of convalescent serum obtained twenty-one days after onset exhibited complement-fixing antibody in significant titer but gave only a low titer in the neutralization test.

CASE 2.—Acute encephalitis, fatal outcome.

On July 7, 1945 the patient, a woman aged 21, suddenly experienced vertigo while walking, soon thereafter had severe headache and fever and took to her bed at once. She became restless and slightly confused; after four days of illness she was unable to understand speech or to communicate with her family. The day before her admission to the hospital, July 13, restless agitation ceased and deep coma supervened. During the first five days of illness fluids were taken fairly well.

Physical examination revealed a well nourished, deeply comatose young woman. The neck was rigid; Kernig's sign was present, and flexion of the thigh caused painful facial grimacing, which revealed a slight weakness of the right side of the face. The pupils were small and fixed to light. Ocular motion was somewhat disassociated. The abdominal reflexes were absent, and tendon reflexes were weakly present.

Examination of the cerebrospinal fluid on admission showed 26 leukocytes per cubic millimeter, of which 40 per cent were lymphocytes. The Pandy test showed a slight increase of globulin. Thick and thin blood smears were negative for plasmodia.

During the first forty-eight hours of hospitalization penicillin was administered intramuscularly in doses of 50,000 units every three hours and intrathecally twice in doses of 15,000 units. On July 15 she was still comatose, and neurologic signs were little altered, although facial weakness was more pronounced. The following day there was evidence of improvement. The patient's eyes were open; she made feeble attempts to speak and tried to cooperate by following simple directions. There were a slight tremor about the mouth and an occasional jerky movement of the extremities. The lower abdominal reflexes were present, and the deep reflexes were somewhat more active. Nuchal stiffness and weakness were pronounced; the back was rigid and flexion of the thigh was limited and painful. General physical examination revealed nothing significant.

On July 18 the patient was semistuporous but made feeble attempts to respond. A coarse tremor of the facial muscles was present, more conspicuous on the right. Passive movement of the extremities caused pain and was resisted. There was a suggestion of cogwheel rigidity of the upper extremities.

This patient was seen during the early phase of the outbreak, before facilities for laboratory study were available. No additional tests were made. After the apparent slight remission, coma deepened; the temperature rose to 105 F., and complete quadriplegia with rigidity of the extremities developed and persisted until death, on July 20.

Autopsy showed no significant visceral lesions. Except for adhesions, at the base of the left lung and a calcific lesion of the upper lobe of this lung, the lungs were clear. The other organs, the lymphatics and the bone marrow were normal. Several Ascaris lumbricoides were found in the small bowel. The scalp, skull and dura were normal. The cerebrum showed convolutional flattening and marked injection of all superficial vessels. The white matter showed multiple areas of pinpoint injection. Similar injection was present in the cerebellum and the cervical portion of the spinal cord.

Histologic examination showed that the leptomeninges were focally infiltrated with lymphocytes in the sulci and the anterior fissure. Perivascular cuffing was present in the substantia nigra, the medulla and anterior horns of the spinal cord. Well circumscribed acellular zones of spongy appearance were widely distributed throughout the cortex, the basal ganglia and the hypothalamic nuclei. There was no reparative gliosis. The substantia nigra showed free melanin from disintegrated neurons. The cerebellum was extensively involved, many folia showing complete loss of Purkinje cells. In the cervical portion of the cord the anterior horn cells were damaged, and there was lymphocytic infiltration similar to that seen in poliomyelitis.

Case 3.—Subacute encephalitis; gradual recovery.

A 5 year old boy complained of headache, fever and stiffness of the neck on August 3. He vomited once during the day. The symptoms persisted; somnolence developed, and by August 6, when he entered the hospital, he was deeply stuporous. His parents noted that an internal squint had developed.

The temperature on admission was 100 F., rose the following morning to 104 F. and descended by irregular spikes during the following four days. He was acutely ill and stuporous and lay quietly on his cot. The pupils were equal but exhibited hippus reaction to light. Ocular motion could not be tested. There was left internal strabismus. The abdominal reflexes were absent; all the deep reflexes were physiologic. Babinski's sign was present bilaterally. The neck was stiff and a neck drop was present; Kernig's sign was positive.

The spinal fluid was clear; there were 86 cells per cubic millimeter, of which 98 per cent were mononuclear. The blood count of August 7 showed 4,230,000 erythrocytes, 12,500 leukocytes, 75 per cent polymorphonuclear leukocytes and 5 per cent band forms. Urinalysis on August 9 revealed albumin, otherwise nothing abnormal. Subsequent laboratory investigations revealed essentially a normal state except that hookworm ova and Strongyloides larvae were found in several specimens of stool. The leukocytosis subsided by the third day in the hospital, and the differential count slowly returned to normal after an initial increase in granulocytes. Three later urinalyses showed nothing abnormal. On August 11 there were 8 cells, all lymphocytes; and on August 20 there were only 4 lymphocytes per cubic millimeter of spinal fluid. The last specimen showed 61.9 mg. of protein and 68 mg. of sugar per hundred cubic centimeters. After treatment with tetrachloroethylene and gentian violet medicinal U. S. P., examination on October 4 showed the stool was no longer positive for ova.

The patient's condition changed but little during the first three or four days. He lay quietly in bed, often with the forearms and wrists flexed. Distention of the bladder was noted on August 9, and catheterization was required for the following nine days. After eight days of coma he improved somewhat but remained apathetic, incontinent when bladder function returned and had persistently positive neurologic signs. The deep reflexes were at first less active, then unequal and finally variably hyperactive. Plantar reflexes were at times positive and associated with unsustained clonus at the ankle, at other times normal. Hypodermoclysis was required for a few days, after which fluids were well taken, and on August 17 he was able to eat solid foods. On the thirty-second day of his illness apathy was suddenly replaced with hyperactivity and irritability. At the same time, nuchal rigidity, which had subsided by August 22, began to be noticeable again and was prominent by September 8. Sedation was necessary. When the effect of medication wore off, sudden outcries or infantile whining occurred. At times restraint was necessary to keep the patient from wandering about unsteadily or falling from his cot. This

period of hyperactivity was followed by a short period of stupor, during which corneal ulceration developed. Later he was unusually quiet but had explosive episodes of violent behavior and shrieking, from which he could be aroused by a slap or a dash of cold water.

The abdominal reflexes were present on August 14 but with the temporary relapse in early September were again suppressed and unequal. Babinski's sign was present at various times until late September. Eventually, however, there was complete clearing from the psychologic standpoint, and the neurologic examination revealed an entirely normal state. The patient was discharged with no residua except for a persistent strabismus. Positive complement fixation was reported with this patient's serum by the NAMRU no. 2 laboratory and by Dr. Hammon, who indicated that the specimen he obtained twenty-eight days after onset gave only a doubtful result in the neutralization test.

CASE 4.—Encephalitis with residual hemiparesis and aphasia.

This case of a 7 year old girl was one of the first to come to the attention of a medical officer on Okinawa. She was brought to a Military Government hospital on July 10 in semicoma, with physical signs which suggested a diagnosis of tetanus to the referring physician.

On July 4, while playing out-of-doors, the child suddenly had an acute headache. She seemed to have a high fever when her mother put her to bed. That night stiffness of the neck was observed, and she had one generalized convulsion. During the following six days convulsions occurred about four times daily; consciousness was progressively more blurred, and for two days there was deepening coma. She took fluids fairly well until two days before admission, with difficulty thereafter. Speech function was disturbed from the outset, and, except for calling out for her mother, she had not spoken for about four days.

On admission the temperature was 100.4 F. and the pulse rate 128 per minute. The patient was comatose. There were a great many moxacautery scars and linear scarification over the anterior portion of the trunk, the forehead and the extremities. The pupils were dilated by a mydriatic on admission. There were irregular rotary movements of the eyes but no nystagmus. Hemiparesis on the right with facial weakness was present; Babinski's sign was positive on the right. Kernig's sign was present bilaterally, and motion of the neck was sharply restricted. A moderate degree of trismus was present. No spontaneous movements or tremors were noted. The swallowing reflex was absent. Abdominal reflexes were not elicited, and tendon reflexes were generally hypoactive, although abortive clonus was occasionally elicited on the right. Examination of the heart, lungs, abdomen and ear, nose and throat revealed no abnormalities.

The cerebrospinal fluid was clear and contained only 6 leukocytes per cubic millimeter on initial examination, on July 10. Globulin was not increased, and a culture was reported as sterile.

The temperature varied between 99.8 and 103.4 F. during the first two days, and slight fever persisted until July 18. Penicillin in doses of 50,000 units was administered intramuscularly every three hours for forty-eight hours, and two injections of 15,000 units were administered intrathecally. Weakness of the right extremities progressed to complete paralysis, and speech function was entirely lost. On the seventeenth day of illness the child was alert but extremely irritable and restless. The reflexes gradually returned and for a time were more active on the left; later the typical reflex changes of upper motor neuron paralysis were present, associated with ankle clonus, pathologic plantar reflexes and increasing spasticity. On August 25 minimal improvement of muscular power was noted, and a week later the child

attempted to walk with support. Aphasia remained unaltered, although simple orders were readily followed and it was evident that speech perception was normal.

When the patient was discharged on September 3, she was able to walk a little with support, the right upper extremity was paralyzed and spastic, the skin was hyperhidrotic and soft, saliva drooled from the right angle of the mouth, irritability persisted but there was no evidence of mental retardation despite complete motor aphasia. The last follow-up examination, on October 22, showed little sign of improvement. She could then walk unsupported, swinging the paretic right leg in an abduction arc and bearing her weight on the toes of the right foot. The upper extremity could be moved passively through about 20 degrees, but purposeful acts could not be accomplished. The arm was maintained in almost complete extension and was spastic.

Laboratory findings were not significant; there was no pleocytosis in any of the three specimens of spinal fluid examined. Dr. Hammon reported that a specimen of serum obtained from this patient fifty days after onset contained both neutralizing and complement-fixing antibodies for the Japanese B encephalitis virus.

Case 5.—Encephalitis with residual quadriplegia and idiocy.

On August 15 a previously normal 5 year old boy became ill suddenly with fever and headache. He was kept at home until August 24, when he was taken to a Military Government hospital at Taira. The parents reported that the child became progressively more stuporous and had been irritable for three days before transfer to the isolation hospital, on August 29. Coma, nuchal rigidity and suppression of reflexes were noted at the first hospital, and the cerebrospinal fluid on August 28 showed 26 cells per cubic millimeter, all mononuclear in type. Pandy's reaction for globulin was positive.

Physical examination on admission showed a quiet, well nourished child who did not appear seriously ill. It was noted, however, that the lower extremities were not voluntarily moved and that there was some degree of flaccidity. The pupils were equal and reacted to light; there was no disorder of the extraocular muscles; the abdominal reflexes were present and active, and the deep reflexes were normal except for the left patellar reflex, which was not elicited. The child was apathetic and did not speak, but he was able to take fluids well. There was slight nuchal rigidity; Kernig's sign was not present.

The cerebrospinal fluid, examined on August 30, showed 50 leukocytes per cubic millimeter, of which 95 per cent were mononuclear; globulin was increased, and there was 82.2 mg. of protein and 50 mg. of sugar, per hundred cubic centimeters. Four days later pleocytosis was no longer present, but Pandy's test showed a 3 plus reaction for globulin; the sugar of the spinal fluid was 43.7 mg. per hundred cubic centimeters. The blood count showed no anemia; the white cells numbered 19,500, of which 80 per cent were granulocytes and 4 per cent band forms. The Kahn reaction was negative; several urinalyses showed nothing significant, and examinations of stool did not disclose ova or parasites.

The patient was fed by gavage and given saline solution by hypodermoclysis during the first week of hospitalization. Thereafter he took milk by mouth and could be fed soft rice and soups. Weakness was progressive, and after three days complete paralysis of all four extremities was noted. For a time about ten days after admission the child seemed more alert, although unable to follow simple commands. The flaccid paralysis then began to show a slight spastic quality. The patient lay in bed with head and eyes deviated to the right; he was incontinent (bladder and bowel) and showed increasing rigidity of the neck and back, with pronounced nuchal weakness. Spasticity of the arms was a forerunner of progressive contracture and postural abnormality (fig. 2). While the thighs remained

flaccid, progressive plantar flexion of the feet developed, more pronounced on the left than the right. Eventually the patient presented a status characterized by loss of all but the most primitive functions, paralysis, deformity and general deterioration. This picture was in the nature of that which was presented by the 4 patients who died after more than a month's illness, but of a less marked degree.

At the time of discharge from the hospital the following description was recorded: "The patient is of the mental level of an idiot; he takes food, cries out in pain, moans when unattended and is incontinent, unresponsive and unable to communicate in any way. He lies in a contorted position with head and eyes turned to the right, the right forearm flexed at the elbow, the fingers clenched and the hand held against the chest. The left forearm is extended and internally rotated, and the wrist and fingers are flexed. The left knee is flexed and rests on the right thigh; the foot is in fixed equinus and internally rotated, the toes are sharply plantar flexed. The right knee is extended, and the foot is plantar flexed. The contractures of the various joints can be passively overcome except at the left foot, left elbow and wrist."

The reflexes varied from day to day. Abdominal reflexes were usually present, and the tendon reflexes were fairly normal at times for about two weeks. Thereafter they were increasingly difficult to elicit and finally only the left knee jerk

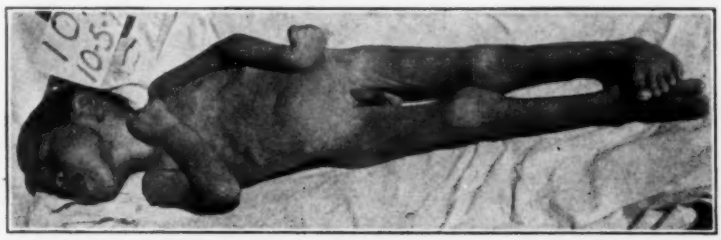

Fig. 2 (case 101).—Patient, fifty-one days after onset of illness. Note deformity of the paralyzed extremities, particularly flexion contracture of the left wrist and hand and the "striatal" foot on the same side.

and the left triceps reflex were present. During the period of almost two months in the hospital there were two febrile episodes, without obvious explanation.

Follow-up examination several weeks after discharge showed no change except increasing inanition. Dr. Hammon reported that a specimen of serum obtained from this patient fourteen days after onset contained neutralizing antibodies and also complement-fixing antibody in low titer.

CASE 6.—Encephalitis: progressive deterioration, fatal outcome.

On September 8, a week after the onset of an acute illness characterized by headache, fever, stiffness of the neck and rigidity of the extremities, a 12 year old girl was brought to the hospital in coma. Consciousness was not regained during the ensuing thirty-five days.

Examination revealed that the patient was somewhat undernourished and comatose, with fixed, pinpoint pupils, an external squint of the right eye, nuchal rigidity and marked restriction in flexion of the thigh. The abdominal reflexes were absent, but the deep reflexes were normal and there were no pathologic plantar signs.

The initial specimen of spinal fluid showed only 9 leukocytes per cubic millimeter, all of which were monocytes; two days later the spinal fluid had no cells, but globulin was slightly increased. The blood count on September 16 showed 13,300

leukocytes, a hemoglobin content of 9.0 Gm. per hundred cubic centimeters and an erythrocyte count of 4,000,000. The differential count was not remarkable. Urinalysis showed a 2 plus reaction for albumin, with no other abnormalities. The plasma protein was normal, and the derived hematocrit reading was 47. Repeated examinations of the stool showed hookworm ova and Strongyloides larvae.

Nutrition was maintained with difficulty with gavage, intravenous administration of fluids and some milk by mouth. During the first week deep coma persisted, and the patient lay quietly with the eyes open and the neck rigidly held in extension. Weakness of the extremities was soon followed by progressive rigidity and beginning disfigurement. The reflexes became hyperactive; sustained ankle clonus was obtained on September 23, and at the same time tremor of the hands was first noted. About this time the head and eyes were deviated to the left; both hands were flexed at the wrists, and the lower extremities were maintained in partial flexion (fig. 3). Flexibilitas cerea of the upper extremities soon developed and was present in some degree until death. The thumbs were held between the middle and the ring finger, a position maintained even when the hands eventually became

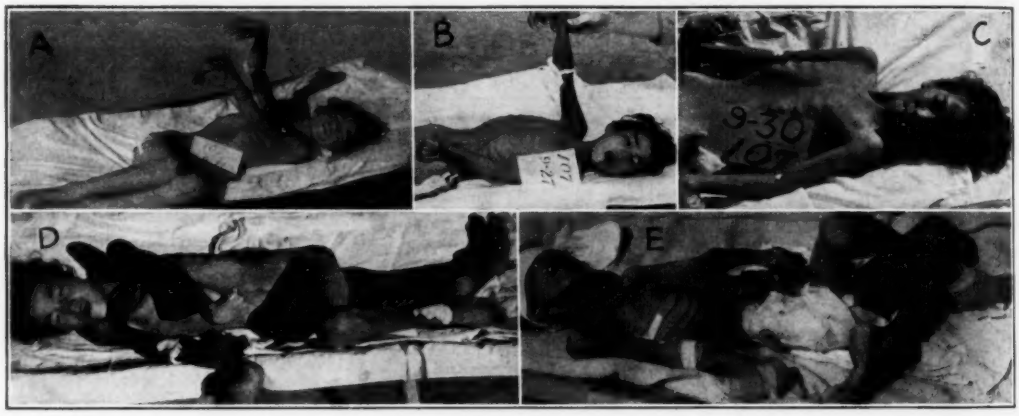

Fig. 3 (case 6).—*A*, twenty days after onset of illness; spontaneous elevation of the upper extremities. *B*, twenty-sixth day of illness; flexion deformity of the hands. *C*, twenty-ninth day; increasing deformity and inanition. *D*, flexion contractures of knees and "striatal" right foot. *E*, terminal phase; extreme deformity and general deterioration.

flexed completely to lie, in the course of time, in direct contact with the volar surfaces of the forearms. Attempts to extend the flexed extremities resulted in grimaces of pain and precipitated universal tremor. The left foot assumed the position of equinus and became progressively more deformed.[19] Clonus was present

19. It is interesting to note that the deformity of the foot in this patient, as well as in the other patients in the chronic stage, with contractures and deterioration, was similar to that which occurs in dystonia musculorum deformans and which is described as the "striatal," or "talon," foot. The pathologic features of this disease, according to Wechsler (A Textbook of Clinical Neurology, ed. 5, Philadelphia, W. B. Saunders Company, 1943, p. 606), are diffuse degenerative changes involving the basal ganglia, midbrain, pons, cerebellum and cerebral cortex. As in encephalitis, designation of focal involvement for the production of deformity, tremor and other disturbances of mobility is rendered extremely uncertain because of the widely scattered lesions.

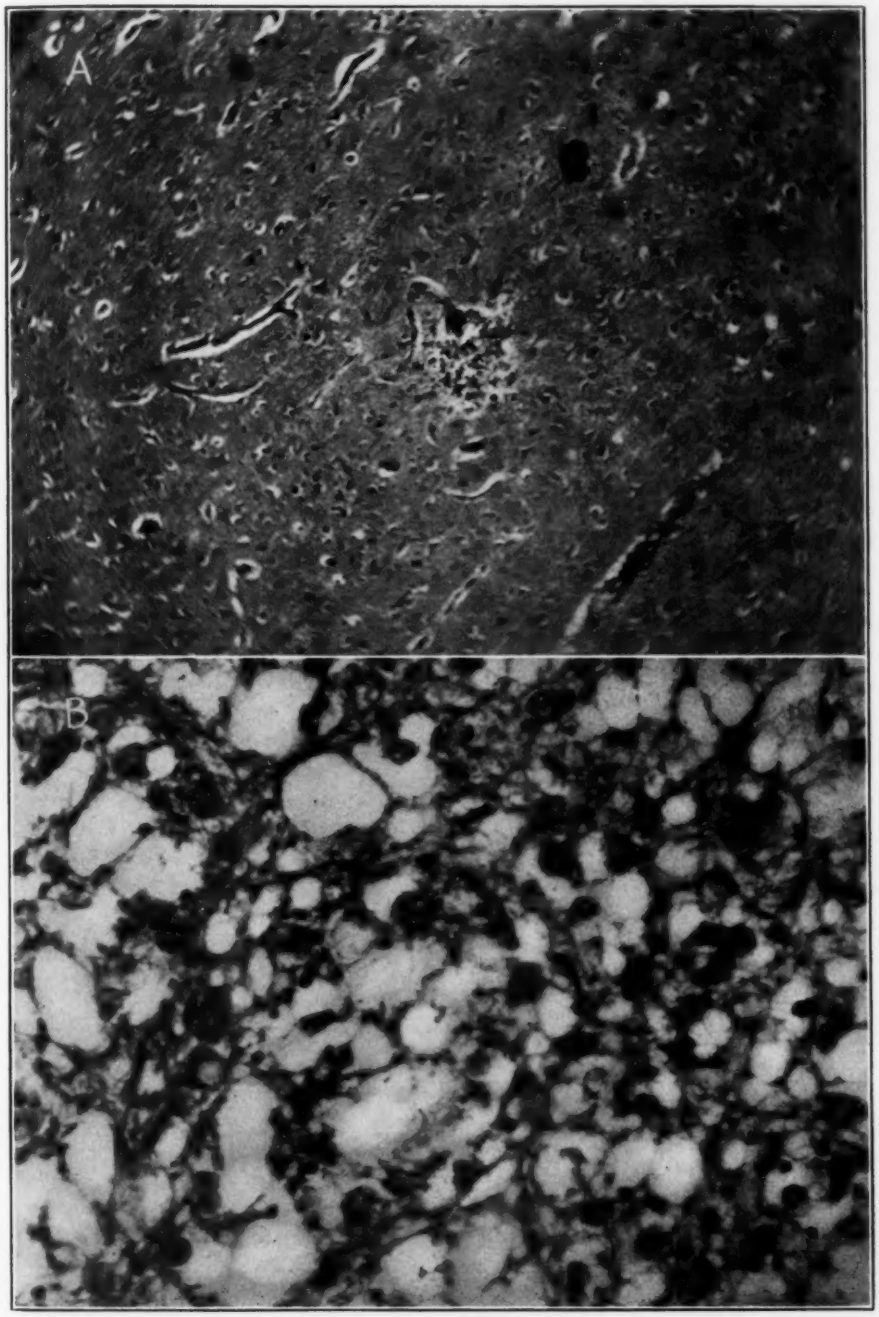

Fig. 4 (case 6).—*A*, focus of necrosis with astrocytic gliosis in the cortical gray matter; × 88. *B*, midbrain (fig. 1 *B*), with softening and fibrillary stroma; × 385.

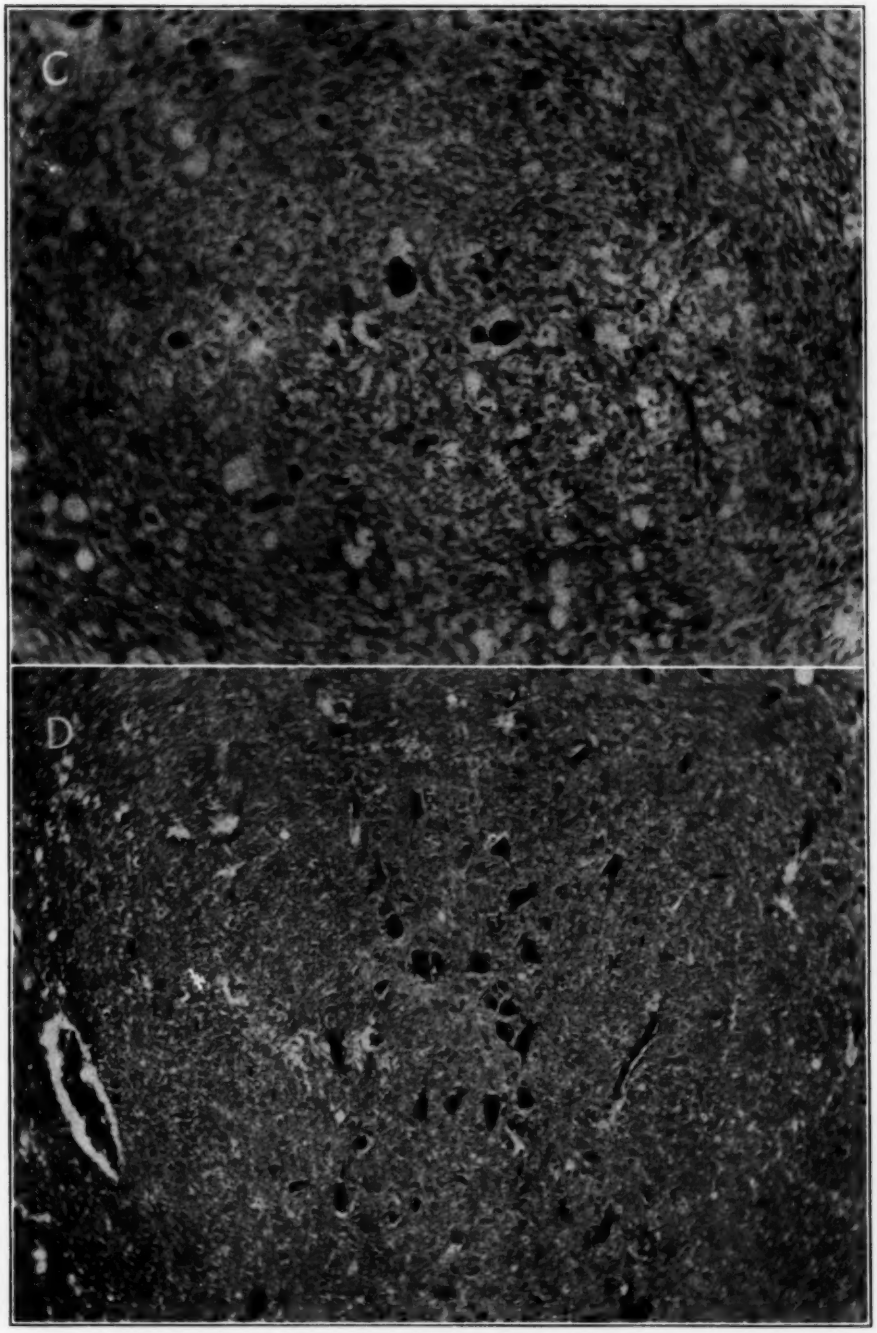

Fig. 4 (continued).—*C*, midbrain, with calcium depositis; × 88. *D*, substantia nigra, with chromatolysis of neurons and glial proliferation; × 88.

on attempted dorsiflexion. Spontaneous elevation of the upper extremities occurred on examination of the lower extremities, and attempted flexion of the neck resulted in increased flexion of the elbows and wrists. Neck drop was not present, but rigidity of the neck and spine was extreme. Decubitus ulceration was at first only moderate in degree, but with increasing deterioration tissue breakdown was unusually rapid. Symmetric bullae appeared at the knees and over the tibial crests; every bony prominence was the site of bluish discoloration and eventually of ulceration. Ultimately the entire sacrum was exposed and both femoral trochanters were denuded. On September 30 tremor of variable intensity was present, involving the facial muscles, the extremities and the trunk. Flexion deformity of the hands, with increasing internal rotation of the upper extremities, resulted in a bizarre position and in ulceration of the radial sides of the forearms from friction on the bedclothes. Spontaneous elevation of the left arm and flexion of the left knee occurred periodically. The mouth was held widely open, and the chin was tremulous. Deformity of the right foot continued to develop until the toes were almost in contact with the skin of the plantar surface, the entire foot forming a fixed arc. Wasting, deformity and rigidity were progressive. Bizarre tremor and spontaneous muscular contractures persisted. During the last three or four days of life the patient was cold and rigid, and the only signs of animation were shallow, infrequent respiration and a faint pulse. Death occurred on the forty-first day of the disease.

During the final three weeks of illness there was an irregular fever, with a maximum temperature of 104 F. Intracutaneous tests with old tuberculin in dilution of 1:10,000 and 1:1,000 gave negative reactions early in October.

Autopsy revealed a wasted, deformed and ulcerated cadaver, the external appearance of which is indicated by the clinical description. The pupils were unequal, the left being larger than the right. The mucosa of the mouth was covered with a thick, dry crust. Incision of the trunk revealed a subcutis devoid of fat and a thin, atrophic musculature. Examination of the viscera revealed no pronounced gross abnormality. Both lungs collapsed and were uniformly crepitant. The myocardium was pale and atrophic. There were slight adhesion of both renal capsules and thinning of the cortex on the right. The hepatic parenchyma appeared somewhat pale, and markings were prominent. The adrenal medulla was congested bilaterally, and the cortex was also congested on the left. The gastrointestinal tract was normal, and no parasites were seen.

The surface of the brain was universally and intensely congested, small vascular radicles forming a prominent network over the entire pial surface. There was considerable convolutional atrophy in the frontal region and at the vertex, involving both parietal lobes. The base of the brain appeared normal. A single cut made into the region of the substantia nigra showed no gross abnormality. When the fixed brain was later sectioned, a gritty sensation was noted on cutting through the basal ganglia.

Histologically, the cortical gray matter showed scattered foci of astrocytic gliosis, probably a later stage of the "plaque" formation seen in earlier specimens (fig. 4*A*). The putamen, caudate nucleus and pallidum were largely devoid of ganglion cells and were replaced by a loose fibrillary stroma (fig. 4*B*). Calcium salt was noted in isolated granules and in clumps, at times within macrophages and multinucleated giant cells (fig. 4*C*). In the caudate nuclei and the substantia nigra (fig. 4*D*) there were small zones of cystic degeneration and also widespread gliosis, replacing melanin-containing neurons in the latter area. The pons had suffered relatively less injury, but the cerebellar folia were partially or completely depleted of Purkinje cells, and there were indications of damage to the interstitium

as well. The cervical portion of the spinal cord revealed little change other than perivascular cuffing.

CASE 7.—Encephalitis with residual psychosis.

On the fourth day of an illness which began with headache, fever and slight chills, a 15 year old girl was admitted to the hospital in coma. She had been stuporous for three days prior to admission.

Examination revealed fair nutrition and no evidence of disease other than that referable to the nervous system. The patient was comatose; the head and eyes were deviated to the right; the upper extremities were somewhat rigidly held, and attempts to move the neck or flex the extremities evoked painful grimaces. The pupils were small and fixed to light. The abdominal reflexes were absent, and only the ankle jerks were elicited. Nuchal stiffness and the Kernig sign were present.

Initial examination of the spinal fluid, on August 21, showed no cells but a slight increase in globulin. On September 6 there were 18 cells per cubic millimeter, all lymphocytes, and a 1 plus reaction for globulin. The sugar was 50 mg. per hundred cubic centimeters. A third examination, on September 20, again did not reveal cells and showed the same increase in globulin. The protein measured 62.5 mg. and the sugar 76.9 mg., per hundred cubic centimeters. There was only slight initial leukocytosis and no anemia. The differential count was normal. Hookworm ova were found in several specimens of stool, even after administration of hexylresorcinol and tetrachloroethylene. The Kahn reaction of the blood was negative. Late in the illness there was an acute febrile episode, and the blood smear was found to be positive for Plasmodium vivax. Treatment with quinacrine hydrochloride (atabrine) was rapidly effectual.

During the first week of hospitalization the patient was quiet and showed pronounced nuchal rigidity, jerky ocular movements, hyperreflexia of the lower extremities, flexion of the upper extremities and resistance to extension and variable pathologic reflexes. For a brief interval there seemed to be indications of improvement: The patient began to take food, seemed to understand simple directions and no longer showed the gross jerky ocular movements described. However, internal strabismus and reflex abnormalities were still present. Mental aberration was first noted about September 4. She soiled herself frequently and no longer seemed to understand directions or inquiries. Her expression was alternately blank and silly or wild; attempts at speech were infrequent and confused. About a week later she was hyperactive, left her bed and dragged the bedclothes about on the floor, entered the beds of other patients and made frequent primitive outcries. Restraint was required for the protection of other patients.

Restlessness increased to the point of continuous agitation and constant, incoherent jabbering. When restrained, she pulled at her bandages and cried out in meaningless sounds. The use of large doses of barbiturates was only partially effective in quieting her. On September 21 Lieut. Comdr. Clark Moloney, psychiatrist at the Military Government Hospital at Jinuza, saw the patient and described her as dystasic, hyperactive, confused, not distractible and restless, with reversion to infantile behavior. The manifestations were considered characteristic of an organic psychosis. At this time the patient threw herself about, walked about the ward on her knees, grimaced constantly, resisted nursing attention and defecated on the floor or in bed.

Wet packs were given daily, at the suggestion of Lieutenant Commander Moloney, and sedation was continued. Until October 13 there was little change. On that date, after administration of a barbiturate and application of wet packs

had failed to quiet the patient, a light chloroform anesthesia was attempted. A short period of apnea ensued, and artificial respiration was required. She then slept quietly for several hours and was quieter the following day. On October 15 she experienced the only lucid interval in her illness: She was able to give her name, age and the name of her village. She recognized being in a hospital but was disoriented as to time and location. She cooperated freely. However, two days later she was again confused at intervals and was noisy and disturbed during the night. Light anesthesia was again attempted on October 18, but without beneficial effect. The condition of the patient remained somewhat better than it was prior to the lucid interval, but the chronicity of her psychotic state was believed established when observation was terminated early in November. During the final period in the hospital there were times when she joined the nurses in singing Okinawan songs, and very occasionally she gave lucid responses. Echolalia was a prominent symptom. She was able to repeat any phrase, English or Japanese, and had none of the commonly encountered difficulty in pronouncing *r* or *l*. Her reactions were generally primitive; her eating habits were animal-like, and infantile mannerisms persisted. Neurologic examination could not be performed. The only abnormality noted was a wide-based, somewhat spastic gait.

NOTE.—Lieut. T. W. Simpson (MC), U. S. N., reexamined this patient in the summer of 1946. A year after the acute episode described, she was reported to have signs of "mild personality change" but was sufficiently well to take care of younger children in her family (Simpson, T. W., and Meiklejohn, G.: Sequelae of Japanese B Encephalitis, to be published).

POSTENCEPHALITIC SYNDROME

While information from Japanese sources was found to be fairly reliable with reference to the symptomatology and course of the acute phase of Japanese B encephalitis, the views which were cited in service publications for the guidance of medical officers[20] tended to minimize the frequency and severity of residual manifestations of the disease. The opinion that patients usually recovered completely or did not survive the disease and that postencephalitic states were rare except in infants and elderly persons was generally stated and was also widely held in Okinawa by native physicians interviewed. The possibility that the particular outbreak of 1945 was unusual in respect to residua warranted a search for evidences of postencephalitis in the local population.

Among the many thousands of civilians who were treated in Military Government hospitals and dispensaries, there were few who showed indications of possible postencephalitic syndromes. However, there were several patients in the neuropsychiatric hospital who showed various forms of organic deterioration and who gave histories of an acute febrile illness during the summer or autumn preceding the development of such symptoms as partial paralysis, rigidity, tremor or personality change. One patient who was studied in some detail showed chiefly cerebellar signs: ataxia, wide-based gait, incoordination, dysmetria, dysdiadokokinesis and nystagmus. There was no mental deterioration and no paralysis.

20. Japanese "B" Encephalitis, Bumed News Letter **5**:1-5 (Feb. 16) 1945.

Although such evidences were found, it is clear that the incidence of postencephalitis is low in view of the supposed frequency of outbreaks of the disease. It is probable that many invalided or disabled persons failed to withstand the hardships of the war, but it must also be recognized that many of the patients who survived during the summer of 1945 because of good medical care would ordinarily have died of inanition, dehydration or complicating infections. Observation of local medical practice and facilities for the care of the sick indicated that parenteral administration of fluids, gavage, adequate use of antibacterial substances and good nursing were not standard therapeutic procedures.

TREATMENT

There is no specific treatment for Japanese B encephalitis. During the period of coma it is urgent that nutrition be maintained by gavage, intravenous administration of fluids and use of vitamin supplements. Depletion of body proteins is sometimes extreme, and the use of plasma or amino acids would probably help prevent decubitus ulceration. There was no opportunity to test the effect of plasma during this outbreak, since the amount available was minimal.

Judicious use of sedatives during periods of restlessness and irritability, frequent changes of posture of comatose patients, catheterization when indicated and similar routine procedures constitute almost all the therapeutic armamentarium available. Frequent lumbar puncture for relief of spinal fluid pressure has been advised in the treatment of encephalitides. In those few cases in which such withdrawal of fluid was practiced there was little indication of benefit. No opinion can be offered as to the advisability of frequent tapping on the basis of this study.

Treatment of complications is of paramount importance, and there can be little doubt that the availability of sulfonamide compounds and penicillin was in part responsible for the relatively low mortality experienced. The nature of the pneumonia frequently found is not certain, but chemotherapy seemed to be effectual in most instances. In some of the early cases large doses of penicillin were given intramuscularly and intrathecally for forty-eight hours. This therapeutic attempt was not followed through, however, since there was not enough of the drug readily available for adequately controlled clinical testing. Although there is no basis for the use of penicillin in virus encephalitis, an adequate therapeutic trial under laboratory control would seem to be indicated, particularly in order to determine the mortality as compared with that in a control group, even if only complicating infections were effectively influenced.

COMMENT

Japanese B encephalitis is one of a large group of arthropod-borne neurotropic virus infections which have been identified as the causes of

serious epidemics and epizootics, as well as endemic foci of disease throughout the world. The epidemiology of many of these infections has been studied in detail, and strains of viruses from animal as well as human infections have been available for research in various scientific institutions. As a consequence, it is now possible to make etiologic diagnoses in most instances, and knowledge of specific agents, common vectors and animal reservoirs facilitates measures for control with use of prophylactic vaccines, insect control or elimination of potential hosts. In this particular instance segregation of native patients and vigorous mosquito control were probably responsible for the low incidence of infection among civilians and a remarkably slight spread to military personnel.[2] The value of prophylactic vaccination could not be accurately appraised, since there was no opportunty for comparison of morbidity in nonvaccinated subjects and the disease did not reach epidemic proportions in the area where troops were bivouacked.

It was previously pointed out that encephalitis is largely a disease of children in the Ryukyus. As in the case of other infectious diseases, this may be interpreted as an indication of a high degree of immunity in the adult population and an evidence of prolonged endemicity of the disease. Sabin [3c] found neutralizing antibodies in 90 per cent of the natives (without history of encephalitis) over 20 years of age (series of 30), in 54 per cent in the age group of 10 to 19 years (series of 11) and in none of 16 persons in the age group of 1 to 9 years. Hammon [3d] reported closely parallel results in a series of 54 normal natives. Positive results were obtained in 87 per cent of persons over 14 years of age (series of 31), in 45 per cent of those 10 to 14 years old (series of 11), in 20 per cent of those 5 to 9 years of age (series of 5) and in none of the 7 under 5 years of age. Thomas and Peck [14] found neutralizing antibodies present in the blood of 27 out of 32 Okinawans over 14 years of age, and in 4 out of 9 children between the ages of 7 and 11, whereas none were detectable by neutralization tests in the blood of 9 infants under 3 years of age.[21]

There are many similarities between Japanese B encephalitis and the common encephalitides of North America. The clinical manifestations of the western equine and the St. Louis type of encephalitis resemble those observed on Okinawa, although generally the American diseases seem less severe, with a mortality of only 5 to 22 per cent, according to Hammon.[22] Residua of the three infections appear to be similar in

21. Until recently the rate of attack was higher in adults on the Japanese main islands. However, according to Hammon (personal communication), "in the last ten years the disease has become one of childhood in Japan, with 85 to 90 per cent of the normal population immune in endemic areas."

22. Hammon, W. M.: The Epidemic Encephalitides of North America, M. Clin. North America **27**:632-650 (May) 1943.

nature and may be equally severe in comparable age groups, although manifestations such as those reported in cases 5 and 6 have not been described in the United States. Typical postencephalitic paralysis agitans is a rare sequel in all three diseases.

Correlation of physical signs and histopathologic changes is difficult because of the extremely widespread nature of the lesions. However, it is interesting that there were few manifestations of cerebellar disturbance in the acute phase of the disease, even though cerebellar injury was most striking in pathologic specimens from cases of the early as well as the late stages. It is possible that signs were masked by interference with function at other levels of motor activity, and it is significant that 1 Okinawan native with a most convincing history of a postencephalitic disorder of the nervous system presented a typical cerebellar syndrome.

The lesion of the Purkinje cells in the cellebellar cortex is a prominent histologic feature of Japanese B encephalitis. Comparable destruction is not encountered with poliomyelitis, nor ordinarily in patients with the western equine, the St. Louis or the von Economo type of encephalitis. The histologic appearance is similar to that which has been described in cases of louping ill, an ovine encephalomyelitis,[23] the virus of which is said to be closely related to that of certain seasonal encephalitides of man. Interestingly, Perdrau,[24] who reexamined pathologic material from the original epidemic of encephalomyelitis known as Australian X disease, described changes in the Purkinje cell almost identical with those described by Zimmerman [4a] and referred to in a previous section. This observation, as well as the similarity of clinical data reported by Cleland and Campbell [25] from New South Wales to those reported here, would suggest that the Japanese B and the Australian X disease are closely related, as has already been suggested by others.[26] Unfortunately, the laboratory strain of virus from the latter disease has been lost, and serologic investigations of possible etiologic relationships cannot be performed.

The importance of specific diagnosis has already been suggested by allusion to the availability of prophylactic vaccine and to the control measures which may be determined by knowing the mode of transmission of the infection. It is gratifying, therefore, to learn that technologic

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23. Brownlee, A., and Wilson, D. R.: Studies in the Histopathology of Louping-Ill, J. Comp. Path. & Therap. **45**:67-92, 1932.

24. Perdrau, J. R.: The Australian Epidemic of Encephalomyelitis (X Disease), J. Path. & Bact. **42**:59-65 (Jan.) 1936.

25. Cleland, J. B., and Campbell, A. W.: Acute Encephalomyelitis: A Clinical and Experimental Investigation of an Australian Epidemic, Brit. M. J. **1**:663-666 (May 31) 1919.

26. Sabin, A. B.: Neurotropic Virus Diseases of Man, J. Pediat. **19**:445-451 (Oct.) 1941.

facilities are being expanded for more detailed study of virus encephalitides in many parts of the world. American occupation forces in Japan, assisted by civilian experts, prepared against the eventuality of a recurrence of the disease in 1946 and established laboratories capable of performing serologic tests, virus isolation and other special studies. Continued coordinated effort, such as that which has been made possible by military exigency, will doubtless greatly increase knowledge of this group of diseases and lead to their eventual control.

SUMMARY

The clinical characteristics of Japanese B encephalitis as observed in an outbreak in the civilian population of Okinawa Shima are presented by means of analysis of symptoms and physical signs in 65 patients, as well as by detailed reports of 7 cases illustrating variations in the course and outcome of the disease.

The disease was most common among children, resulting in a mortality of approximately 20 per cent, and caused significant permanent disorder of the nervous system of variable degree in at least one fifth of the patients. The manifestations were characteristic of a diffuse encephalomyelitis and resembled those of other neurotropic virus infections. The results of studies of the cerebrospinal fluid and blood are reported, and the results of serologic tests performed by collaborators are discussed.

The gross and histopathologic abnormalities of the nervous system are described, and the lesions are compared with those of other virus encephalitides.

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INCIDENCE OF ANISOCORIA AND DIFFERENCE IN SIZE OF PALPEBRAL FISSURES IN FIVE HUNDRED NORMAL SUBJECTS

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THIS STUDY was made on patients visiting the Consultation Service of the Mount Sinai Hospital (New York). The 500 patients selected showed no neurologic abnormality aside from the two factors under study. In no instance were patients included whose history or neurologic examination could explain the presence of the abnormalities under investigation. These subjects could, therefore, be considered representative of the neurologically sound population. The sexes were about equally represented: 245 males and 255 females. They were of all ages, but most of them were in the third, fourth and fifth decades of life.

PRESENT INVESTIGATION

Method of Examination.—The pupils were examined by having the sitting patient look at the ceiling. A flashlight was directed toward the eyes from below upward in such a manner as to reveal the pupillary outline without causing constriction. Inasmuch as minute differences in pupillary size were not being looked for, no measurements were made. I was concerned with the incidence of an obvious anisocoria, such as might be detected by any careful examiner. The pupils were characterized therefore as equal, perceptibly unequal and markedly unequal. The same criteria were applied to the estimation of differences in the palpebral fissures.

Observations.—Pupils: Equal pupils were noted in 396, or 79.2 of the total number. In 104 subjects (20.8 per cent) the pupils were unequal. Males and females were equally represented—by 52 each. The right pupil was the larger in 54 patients (10.8 per cent) and the left in 50 patients (10.0 per cent). The inequality was clearly perceptible in 84 patients (16.8 per cent) and was pronounced in 20 patients (4.0 per cent).

Palpebral Fissures: Equal palpebral fissures were noted in 293 patients (58.6 per cent). In 207 patients (41.4 per cent) they were unequal, the right being larger in 110 (22.0 per cent) and the left in 97 (19.4 per cent). The inequality was clearly perceptible in 179 subjects (35.8 per cent) and pronounced in 28 (5.6 per cent). It is

From the Consultation Service, Herman Lande, M.D., Medical Director, and the Neurological Service, I. S. Wechsler, M.D., Chief, of the Mount Sinai Hospital.

evident that the incidence of inequality of the palpebral fissures was about twice the incidence of the anisocoria.

Correlation of Anisocoria with Inequality of Palpebral Fissures.—In 56 patients with anisocoria the abnormality was associated with unequal palpebral fissures (53.8 per cent of the total number of persons with anisocoria). The larger pupil was on the same side as the wider fissure in 44 patients (42.3 per cent) and on the opposite side in 12 patients (11.5 per cent). This indicates that when the two abnormalities coexisted the wider pupil and the wider fissure were on the same side nearly four times as frequently as on opposite sides. In 48 patients (46.2 per cent of the total number with anisocoria) the palpebral fissures were equal. Hence anisocoria was accompanied with inequality of the palpebral fissures in about one-half the patients. On the other hand, 151 patients with unequal palpebral fissures (73 per cent of the total number with unequal palpebral fissures) had associated equal pupils.

COMMENT

An earlier view that anisocoria is always pathologic has in recent years undergone some modification. Fuchs [1] recognized the occasional occurrence of congenital anisocoria, a condition which he stated could be recognized from the fact that it has existed throughout the lifetime of the patient, that there is no disturbance in innervation and that the two pupils react equally well. He warned, however, that in general anisocoria is otherwise to be looked on as a pathologic condition. De Schweinitz [2] stated that the earlier view that inequality of the pupils is always pathologic is subject to revision. He agreed that one could speak of pathologic and nonpathologic anisocoria and that slight differences in the width of the pupils may be compatible with perfect ocular and general health. He cited the assertion of Uhthoff that in nonpathologic anisocoria the pupils are round and react normally, which is not the case with pathologic pupillary inequality. Brooks,[3] however, concluded that anisocoria is always pathologic unless it is due to disease of the eyes or to errors of refraction. Behr [4] conceded that anisocoria could be congenital, but he stated that in such cases the difference between the size of the pupils is slight and attributed it to structural differ-

1. Fuchs, E.: Diseases of the Eye, ed. 10, New York, J. B. Lippincott Company, 1932.

2. de Schweinitz, G. E.: Diseases of the Eye, ed. 10, Philadelphia, W. B. Saunders Company, 1924.

3. Brooks, E. B.: Significance of Unequal Pupils, J. A. M. A. **76**:1145-1147 (April 23) 1921.

4. Behr, C.: Ergebnisse der Pupillenforschung, Zentralbl. f. d. ges. Ophth. **32**: 241-257, 1934.

ences in the globe. Collier and Adie [5] claimed, too, that anisocoria may be congenital or associated with inequalities of the refraction of the two eyes. French [6] declared that "inequality of the size of the pupils is observed frequently and may have no pathological significance."

Despite these, and other, statements on the matter, it is difficult to find reports in the literature of studies on large numbers of subjects in order to determine the actual incidence of anisocoria. Barrie [7] examined 326 men and found anisocoria in 35, or about 11 per cent, none of whom showed signs either of ocular disease or of involvement of the central nervous system. The left pupil was larger in 21 men; the right, in 14. He concluded that anisocoria was a frequent physiologic condition and that it may be associated with all refractive errors, especially myopia. He further stated that visual acuity was not adversely affected by anisocoria. A larger study was reported by Snell and Cormack,[8] who examined 3,000 prisoners and found anisocoria in 576 on the night of their reception at the prison. When reexamined the next morning, after a night's rest, however, 281 (48.8 per cent) of the original 576 men no longer showed any pupillary inequality, a finding which the authors suggested might be due to the effect of fatigue. Persistent anisocoria was noted in 295, or 9.8 per cent of the total number. The authors divided their cases on the basis of +, ++ and +++, according to the magnitude of the difference in pupillary diameter.

Left Pupil Greater	Right Pupil Greater	Per Cent of Total Series
110 +	75 +	63
54 ++	41 ++	32
9 +++	6 +++	5
173	122	100

Excluding the men who presented a history of syphilis (30, or 10.1 per cent), errors of refraction (62, or 21 per cent) and various other conditions (such as head injury, local ocular conditions, aneurysm of the aorta, goiter and torticollis, 21.1 per cent), the authors found 139 men with anisocoria in whom the history and physical examinations revealed no abnormality (about 5 per cent of the total number). This incidence is about one-fourth that reported in the present study, whereas the original examination of Snell and Cormack, on the evening of admission to the prison, disclosed an incidence of anisocoria (19.2 per cent) which corresponds closely to the Mount Sinai Hospital findings.

5. Collier, J., and Adie, W. J., in Price, F. W.: Textbook of the Practice of Medicine, ed. 2, London, Oxford University Press, 1926.

6. French, H.: Index of Differential Diagnosis, ed. 4, New York, William Wood & Company, 1928.

7. Barrie, T. S.: Inequality of Pupils, Brit. M. J. **2**:514, 1918.

8. Snell, H. K., and Cormack, G. A.; Incidence of Unequal Pupils in Unconvicted Prisoners, Brit. M. J. **1**:672-673, 1938.

That anisocoria can disappear within a twelve hour period is noteworthy and probably accounts for some of the discrepancies between the findings of various investigators.

I know of no other studies on large numbers of subjects.

Unilateral mydriasis or miosis has been noted in association with a wide variety of non-neurologic conditions. Irritation or paralysis of the sympathetic pathways to the pupil may be produced by mediastinal neoplasm, disease of the heart and aorta and apical tuberculosis.[4] It has also been found in association with local pathologic conditions in the neck, peritonsillar abscess,[4] disease of the middle ear,[9] sinusitis [2] and dental conditions.[10] Salmon [11] noted unilateral pupillary dilatation in several cases of ruptured ectopic pregnancy, which he attributed to the effect of irritation of the diaphragm by the intra-abdominal hemorrhage, a factor which similarly seemed to explain the occurrence of pain in the shoulder in these patients.

The fact that in the series being reported a narrower palpebral fissure was found on the side of the smaller pupil in 77.5 per cent of the cases in which both structures were asymmetric might suggest a sympathetic nervous system factor. It must be added, however, that in nearly one-half the patients with anisocoria the palpebral fissures were roughly equal and, further, that in 73 per cent of the patients with inequality of the fissures the pupils were approximately equal. The general clinical picture, moreover, did not provide any evidence of gross involvement of the cervical sympathetic pathways by extrinsic factors: There were no cases of pulmonary tuberculosis, tumor of the superior sulcus, mediastinal disease or significant disease of the aorta or heart. Patients with pathologic conditions in the neck were not included; nor were those with outspoken otologic disease, although the ears were not routinely examined. Patients with obvious local ocular disease were excluded from the series, but studies on differences in refractive errors between the two eyes were not carried out. Moreover, even if some of the cases of anisocoria are to be explained on the latter basis this would in a sense still constitute a "normal" incidence. Reference has already been made to the observation by Snell and Cormack that anisocoria may be noted at one time and not at another. This may be pertinent in the current study, inasmuch as the patients were examined but once. Furthermore, many of the patients presented evidence of an anxiety hysteria, which suggests that the factor of emotional tension may play a role comparable to that which Snell and Cormack attributed to fatigue. (It is certainly true that differences in the size of the

9. Berberich, J.: Pupillary Reactions in Affections of the Ear, Laryngoscope **50**:555-558, 1940.

10. Piperno, A.: Anisocoria of Dental Origin, J. Am. Dent. A. **21**:1459-1461, 1934.

11. Salmon, U. J.: Pupillary Sign in Ruptured Ectopic Pregnancy, Am. J. Obst. & Gynec. **28**:241-243, 1934.

palpebral fissures are very common and, further, that such differences are in some persons quite variable from time to time. Occasionally, after noting an obviously wider fissure on one side, the examiner would later observe just the reverse. Such cases, however, were not reported as manifesting a difference.)

Whatever the cause, the conclusion is justified that there is a "normal" incidence of anisocoria, at least in persons who complain of ill health. In the majority of patients such inequality of pupils was slight, however, and could have been overlooked in a careless examination. In 4 per cent of the patients the inequality was marked. The incidence of unequal palpebral fissures is, similarly, far greater than can be explained on the basis of gross lesions and is also greater than the incidence of anisocoria.

These observations should not be utilized, however, as a justification for disregarding the possible significance of any anisocoria which happens to be noted. Such a conclusion would make this communication a distinct disservice to medical practice. On the contrary, every instance of anisocoria should be considered pathologic and significant until proved otherwise. The purpose of this study is simply to show that this condition has a normal incidence and is occasionally, therefore, without significance.

SUMMARY

Five hundred neurologically normal persons were studied with reference to the incidence of anisocoria and of differences in the width of the palpebral fissures. Nearly 17 per cent of the patients showed a slight but perceptible anisocoria. In 4 per cent the difference in pupillary size was pronounced. Inequality of the palpebral fissures of a slight degree was noted in nearly 36 per cent of the patients. Pronounced differences were noted in nearly 6 per cent. When both the pupils and the fissures were unequal, the smaller pupil and the narrower fissure were on the same side in 77 per cent of the patients. However, in nearly one-half the patients with anisocoria the fissures were equal, and inequality of the fissures was accompanied with equality of the pupils in 73 per cent of the patients revealing unequal fissures. Consequently, inequality or imbalance of sympathetic innervation could be held responsible for at least some instances of the observed anisocoria, but in general no gross factor could be identified as responsible for any asymmetry of sympathetic stimulation. In other instances differences in errors of refraction may play a role in causing unequal pupils. The incidence of inequality of the palpebral fissures is relatively high, and mild degrees may be considered without significance. Anisocoria should never be dismissed as an anomaly until a thorough search reveals no etiologic basis for it.

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RELATION OF MENTAL IMAGERY TO HALLUCINATIONS

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THE CONCEPT that hallucinations are exaggerations of mental imagery has been long in dying. Previous to the present study, the relationship of mental imagery to hallucinations has been investigated experimentally only four times: first by Mourgue,[1] in 1932; then by Cohen,[2] in 1938; then by Snyder and Cohen,[3] in 1940, and, finally, by Roman and Landis,[4] in 1945. So far as visual and auditory hallucinations are concerned, none of these investigations revealed a direct relationship between the predominating type of mental imagery and the modality of hallucination. Furthermore, our analysis of Cohen's data suggests that with respect to auditory hallucinations there might even be a direct relationship between hallucinations in this modality and relatively deficient imagery in this modality.

The purpose of the present paper is to describe a more extensive investigation than any of the four just mentioned, in which it has been found not only that there is no direct relationship between the predominating type of mental imagery and the modality of hallucination, but that there is a direct relationship between relatively deficient auditory imagery and auditory hallucinations. Enough emphasis will be placed on this observation so that, it is hoped, the concept that hallucinations are exaggerations of mental imagery will no longer be considered seriously but will be properly relegated to that limbo in which are interred those ideas and concepts which have appeared very plausible but which have not been substantiated by experimental investigation.

Before the present investigation is described, it will be convenient to review briefly what other writers have said, and what other investigators

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1. Mourgue, R.: Neurobiologie de l'hallucination, Brussels, Lamertin, 1932, p. 426.

2. Cohen, L. H.: Imagery and Its Relations to Schizophrenic Symptoms, J. Ment. Sc. **84**:284 (March) 1938.

3. Snyder, W. U., and Cohen, L. H.: Validity of Imagery-Testing in Schizophrenia, Character & Personality **9**:36 (Sept.) 1940.

4. Roman, R., and Landis, C.: Hallucinations and Mental Imagery, J. Nerv. & Ment. Dis. **102**:327 (Oct.) 1945.

have found, regarding the relationship of mental imagery to hallucinations. In 1881 Sully [5] stated:

> . . . hallucinations of the insane are due to a projection of mental images which have gained a preternatural persistence and vividness.

Binet and Fere [6] subscribed to this same concept in 1885. Other authors who concurred with this view were Prince,[7] in 1922, and Guiraud and Le Cannu,[8] in 1929. Opposed to the concept that hallucinations are exaggerated mental images were Kadinsky,[9] in 1881, and de Clerambault,[10] in 1924. Kadinsky, subject to hallucinations himself, stated:

> In spite of the old widespread theory, in no case can an hallucination arise from a mnemonic sensorial image.

Mourgue [1] was the first investigator to study in a systematic experimental way the relationship between the predominating type of mental imagery and the modality of hallucination; but his report consisted of only 1 case, that of a woman who had had auditory hallucinations for three years but in whom visual imagery predominated.

The first extensive experimental study of the relationship of mental imagery to hallucinations was reported by Cohen [2] in 1938. That report is valuable not only for the data presented but for its extensive review of the literature on imagery and on the relationship of imagery to hallucinations. According to that review, most people do have a predominating type of imagery that is characteristic for them. Cohen studied the various modalities of mental imagery in 19 schizophrenic patients and in 19 normal control subjects. He compared the mean percentages of the different types of imagery in the patients with the mean percentages of the various types in the subjects. He then compared the predominating type of mental imagery of each patient with the modality in which that patient had hallucinations. From these comparisons he concluded:

> There is no relationship between visual imagery and visual hallucinations, nor, strictly speaking, between auditory imagery and auditory hallucinations.

He added, however, that he had found a positive correlation between

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5. Sully, J.: Illusions: A Psychological Study, London, Kegan Paul, 1881, p. 372.

6. Binet, A., and Fere, C.: La theorie physiologique de l'hallucinations, Rev. Scient. **9**:49, 1885.

7. Prince, M.: An Experimental Study of the Mechanisms of Hallucinations, J. Nerv. & Ment. Dis. **56**:248, 1922; Experimental Study of Mechanism of Hallucinations, Arch. Neurol. & Psychiat. **7**:780 (June) 1922.

8. Guiraud, M. P., and Le Cannu, Y.: Symptômes primitifs et secondaires de la psychose hallucinatoire chronique, Ann. méd.-psychol. **87**:422, 1929.

9. Kadinsky, V.: Zur Lehre von den Hallucinationen, Arch. f. Psychiat. **11**: 453, 1881.

10. de Clerambault, G. G.: Les psychoses hallucinatoires chroniques: Analyse, Bull. Soc. clin. de méd. ment. **12**:17, 1924.

kinesthetic hallucinations and increased kinesthetic imagery, and also between "somatic hallucinations" and increased "body imagery," that is, kinesthetic, tactual-temperature and olfactory-gustatory imagery. He then concluded:

> . . . the relationships of imagery and hallucinations are different for the visual and auditory modalities than for the kinesthetic, tactual-temperature and olfactory-gustatory modalities.

It should, however, be pointed out that the positive correlation Cohen found between increased kinesthetic imagery and kinesthetic hallucinations may depend on his arbitrary, and perhaps indefensible, assumption that ". . . auditory hallucinations which serve as ideas of influence" are kinesthetic hallucinations. If he had not followed that assumption, his data might even have failed to show a positive correlation between increased kinesthetic imagery and kinesthetic hallucinations.

In 1940 Snyder and Cohen [3] studied the validity of testing mental imagery in schizophrenic patients. Although their study was not addressed directly to the problem of the relationship of mental imagery to hallucinations, it does have an indirect influence on that problem because it raises questions about the validity of testing schizophrenic patients with the test previously used by Cohen, and therefore about results obtained with that test. We find that from our study we have data that answer quite adequately all the questions raised by Snyder and Cohen about the validity of testing mental imagery in schizophrenic patients. These data will be presented and discussed at appropriate points in this paper.

The most recent experimental study of the relationship between the predominating type of mental imagery and the modality of hallucination was made in 1945 by Roman and Landis,[4] who collected evidence on the following two points:

> (1) Is there any relationship between the predominant types of mental imagery and types of hallucinations found in psychotic patients; and (2) is there any subjective similarity between experiences of hallucinations and imagery among psychotic patients?

They used a "standardized interview" test that placed emphasis on the intensity of the imagery. The conclusions to which they came were confined to the visual and auditory modalities because hallucinations in the other modalities were so infrequently encountered. Roman and Landis concluded that their findings did not confirm the hypothesis that "hallucinations are but exaggerated imagery processes," but that their data, "by the nature of the method used," could not disprove that hypothesis. They did, however, insist that their study had clarified the issue enough so that if that hypothesis were "to be held and used further" there must be produced more experimental data to support it than exist

at present. With respect to subjective similarity between experiences of hallucinations and imagery, they found that "all patients stated that the experience of hallucination was both qualitatively and quantitatively different from mental imagery." And so the statements of these patients have brought the problem of the relationship of hallucinations to mental imagery back to where, in 1881, Kadinsky,[9] who was subject to hallucinations himself, had tried to place it when he argued against "the old widespread theory" and insisted that "in no case can an hallucination arise from a mnemonic sensorial image.[11]

As has already been indicated, the present study was designed to be extensive enough and detailed enough that definite statements could be made about the presence, or the absence, of a direct relationship between the predominating type of mental imagery and the modality of hallucination, and also about the possibility of a direct relationship between a relatively deficient type of mental imagery and the modality of hallucination. In order to show how the work of this study was divided between us, it should be stated that one of us (P. S), who did all the testing, was not aware that the other's analysis of some data obtained by him with the Kohs Block Design Test, as well as his analysis of Cohen's data, had suggested to him the possibility of a direct relationship between a relatively deficient type of imagery and the modality of hallucination. One of us (P. S.) became aware of the possibility of such a relationship independently when he saw it emerging from the data he was collecting. It can be said, therefore, that we detected this relationship independently, from different sources of information and by different methods of approach.

This study has been oriented and organized with respect to auditory hallucinations not only because auditory hallucinations occur most frequently but because they are the most readily ascertainable, and also the least equivocal, of the different modalities of hallucinations. Therefore, the conclusions drawn from the data of this study will apply only to auditory hallucinations, even though they may appear to have a more general applicability. This study has been supplemented by studying the mental imagery of 10 patients with alcoholic hallucinosis who had had auditory hallucinations but who were completely recovered and ready for discharge when tested. The value of thus supplementing our study will be pointed out and discussed later.

MATERIAL AND METHOD

The test used in this study for determination of mental imagery was the same as that selected by Cohen [2] for his investigations. It is the so-called test of "concrete imagery," published in the appendix to C. H. Griffitt's "Fundamentals

11. Griffitts, C. H.: Fundamentals of Vocational Psychology, New York, The Macmillan Company, 1924, p. 372.

of Vocational Psychology.[11] The test consists of 130 test words and phrases to which the patient or subject responds with his initial mental image. After the test was explained to the patient in a standardized manner, routine examples were tried until the examiner was convinced that the patient fully understood the test. A dictaphone was used for recording the responses verbatim. All the patients were tested by this individual method. The normal subjects were tested in a different manner: Two groups of student nurses—44 in one group and 70 in another, totaling 114—were assembled in a small auditorium and were supplied with recording paper and writing implements. The examiner explained the test in the usual manner, including the use of the routine examples. The nurses then wrote down their imagery responses as the examiner recited the test phrases to the group. This method operated satisfactorily and proved to be a rapid method of obtaining a large group of normal records. Since the mean percentages from this group testing coincide almost identically with the mean percentages from Cohen's normal subjects, who were tested individually, the results of the group method are assumed to be valid.

The patients used in this study were selected from the psychiatric service of the Malcolm A. Bliss Psychopathic Institute of the St. Louis City Hospital. The patients were chosen for testing at staff conferences; no patient was selected who seemed unable to cope with the test, so that the testing was not hampered by such factors as inattention or uncooperativeness. Only 5 patients who were selected for testing had to be abandoned, and these were patients who became excited or were unable to cooperate satisfactorily. Experimental results are reported from 40 patients with schizophrenia and 10 patients who had recovered from an alcoholic hallucinosis.

The schizophrenic patients represented two groups of 20 patients each. One group included schizophrenic patients with definite, unequivocal auditory hallucinations. The other group, of 20 patients, included schizophrenic patients considered to be without auditory hallucinations. In order for a patient to be included in the series with auditory hallucinations, he must have experienced audible hallucinations; he must have experienced hallucinatory sound. To be included in the series of patients without auditory hallucinations, the patient must have experienced no audible hallucinations, i. e., no hallucinatory sound. The investigators were careful not to include as patients with auditory hallucinations those who merely experienced marked ideas of reference and/or influence without actually experiencing hallucinatory sound; examples of such patients are those who complain that "thoughts" are put into their minds. We did not consider any such projection experience an auditory hallucination unless the patient experienced hallucinatory, audible sound.

The case of the 10 patients who had recovered from alcoholic hallucinosis were all of the unequivocal type seen in staff conferences during the period of this investigation; these patients were taken as they came, without selection. All 10 had had marked auditory hallucinations; but they were tested after their psychoses and hallucinations had disappeared completely, when they were ready for discharge.

DATA AND RESULTS

The data obtained from the imagery tests on 40 schizophrenic patients are presented in table 1. The presence or absence of hallucinations in any modality has been indicated by placing the percentage of imagery for that modality either in the "hallucination" or in the "no hallucination"

column; furthermore, the first 20 patients indicated in the table are those with auditory hallucinations, and the second 20 are those without auditory hallucinations. It will be noted that the mean percentage of auditory imagery for the 20 patients with auditory hallucinations is 10.0 lower than that for the 20 patients without auditory hallucinations; this difference is highly significant statistically $t = 4.018$; $P < 0.01$. Similarly, the mean percentage of visual imagery for the 11 patients with visual hallucinations is 14.4 lower than that for the 29 patients without visual hallucinations; this difference is also highly significant $t = 4.778$; $P < 0.01$. The mean percentage of kinesthetic imagery for the 6 patients with kinesthetic hallucinations is 11.8 lower than that for the 34 patients without kinesthetic hallucinations; this difference is also highly significant: $t = 2.757$; $P < 0.01$. The difference between the mean percentages of olfactory-gustatory imagery for the patients with hallucinations and the patients without hallucinations is not statistically significant.

It should be emphasized here that this series of schizophrenic patients was selected with respect to the presence or absence of auditory hallucinations. Since one-half the patients in the series had auditory hallucinations with relatively low percentages of auditory imagery, they must necessarily have relatively high percentages in some of the other modalities. For this reason, the mean percentages of imagery will be increased in some of the modalities in which the patients with auditory hallucinations did not hallucinate. It will be seen that this compensatory increase occurred particularly in the visual and kinesthetic modalities: The mean percentage of auditory imagery for the patients without auditory hallucinations is essentially the same as the respective mean for the normal subjects, as indicated at the bottom of table 1, whereas the mean percentages of visual and kinesthetic imagery for the patients without hallucinations in those modalities are considerably greater than the respective means for the normal subjects. It seems to us that the statistically significant differences found between mental imagery and hallucinations in the visual and kinesthetic modalities depend, at least in part, on the relationship between relatively low auditory imagery and auditory hallucinations, and so are in part but indirect manifestations of that relationship. Therefore, the conclusions to be drawn will apply only to the auditory modality. It is felt that any conclusions concerning the visual or kinesthetic modalities will have to be drawn from investigations organized with respect to visual or kinesthetic hallucinations, just as the present study has been organized with respect to auditory hallucinations.

Qualitative observations made during the testing of the 40 schizophrenic patients gave the impression that the patients with auditory hallucinations were able to cooperate in the test just as well as the patients without auditory hallucinations. This impression is supported by the fact that the means of the scorable responses for the two groups

TABLE 1.—*Percentages of Mental Imagery in Schizophrenic Patients*

Patient	Auditory		Visual		Kinesthetic		Tactile-Temperature,	Olfactory-Gustatory	
	Hallucination	No Hallucination	Hallucination	No Hallucination	Hallucination	No Hallucination	No Hallucination	Hallucination	No Hallucination
AH-1	1.6			77.5		20.9	0.0		0.0
AH-2	3.1			86.2	3.1		5.4		2.3
AH-3	5.4			82.3		6.9	3.1	2.3	
AH-4	8.2			42.7		31.8	12.7		4.6
AH-5	9.5			47.2		35.4	6.3		1.6
AH-6	9.8		22.3			46.4	14.3		7.2
AH-7	10.1			28.2		35.0	15.5		10.5
AH-8	10.8			63.1		18.5	6.2	1.5	
AH-9	11.8			43.1		25.5	9.8		9.8
AH-10	13.0		36.4			36.4	10.4		3.9
AH-11	13.4			19.9		51.6	13.4		1.6
AH-12	15.9		29.4			47.6	5.5		1.6
AH-13	16.4			24.6		36.9	14.8	7.4	
AH-14	16.9			35.4		28.1	13.8		10.8
AH-15	17.1		13.2		26.4		22.5		20.9
AH-16	18.5		30.6		25.0		11.3		14.5
AH-17	18.9			23.5		40.0	12.6		4.9
AH-18	20.1			27.1		27.8	13.4		11.0
AH-19	28.5		7.8			28.5	18.1		17.2
AH-20	31.5		9.2			20.0	19.2		20.0
NAH-1		12.5		40.6		21.1	13.3	12.5	
NAH-2		16.4		39.1		15.6	20.3		8.6
NAH-3		17.5		42.1		29.4	5.5		5.5
NAH-4		19.0		27.8		37.3	7.9		7.9
NAH-5		19.4		22.2		33.3	9.7		15.3
NAH-6		19.8	18.0			26.2	18.8		16.5
NAH-7		19.8	29.2			36.8	7.5		6.6
NAH-8		20.0		28.5		20.0	17.7		13.8
NAH-9		20.3		33.6		25.0	11.7		9.4
NAH-10		20.9		21.7		31.8	13.2		12.4
NAH-11		21.8		23.6		43.6	5.5		5.5
NAH-12		22.5		16.3		29.5	15.5		16.3
NAH-13		26.2		23.8	18.5		22.3		9.2
NAH-14		28.7		31.1		14.8	15.6	9.8	
NAH-15		29.1	12.8			21.4	17.1		19.7
NAH-16		30.0		24.6	15.4		17.7		12.3
NAH-17		32.2		13.6		27.1	16.1	11.0	
NAH-18		32.3	20.7		12.3		16.2		18.5
NAH-19		34.6		18.5		11.5	22.3		13.1
NAH-20		37.5		15.6		15.6	16.4		14.3
Number of patients	20	20	11	29	6	34	40	6	34
Mean percentages	14.0	24.0	20.9	35.3	16.8	28.6	13.0	7.4	10.2
Means for 114 normal subjects	23.2		25.2		21.5		15.9	14.2	

TABLE 2.—*Comparison of Mean Percentages of Auditory Imagery for Schizophrenic Patients With and Without Auditory Hallucinations and for Normal Subjects*

Group	No. of Cases	Mean % Auditory Imagery	σ^m	t	P
Schizophrenic patients with auditory hallucinations	20	14.0	1.725	4.018	<0.01
Schizophrenic patients without auditory hallucinations	20	24.0	1.105		
Schizophrenic patients with auditory hallucinations	20	14.0	1.725	5.165	<0.01
Normal subjects	114	23.2	0.443		
Schizophrenic patients without auditory hallucinations	20	24.0	1.105	0.6717	>0.05
Normal subjects	114	23.2	0.443		

do not differ significantly: $t = 0.897$; $P > 0.05$. It should be noted, however, that the means of the scorable responses for both groups are significantly lower than the means for the normal subjects.

The three comparisons made in table 2 demonstrate that the mean percentage of auditory imagery for the schizophrenic patients with auditory hallucinations is significantly lower than that for the normal subjects; on the other hand, the schizophrenic patients without auditory hallucinations do not differ significantly from the normal subjects in this respect. These results indicate that the schizophrenic process, per se, is not responsible for the low percentage of auditory imagery in the schizophrenic patients with auditory hallucinations.

TABLE 3.—*Percentages of Mental Imagery in Patients Recovered from Alcoholic Hallucinosis*

Patient	Auditory	Visual	Kinesthetic	Tactile-Thermal	Olfactory-Gustatory
Alc-1	6.9*	62.3	22.3	5.4	3.1
Alc-2	8.7*	68.7	9.4	11.7*	1.5*
Alc-3	10.5*	50.9	21.8	9.7	7.2
Alc-4	13.8*	42.3	16.2	16.9	10.8
Alc-5	15.6*	40.6	32.0	7.8	4.0
Alc-6	15.6*	45.3	18.8	11.7	8.6
Alc-7	16.2*	34.6	29.2	12.3	7.7
Alc-8	16.5*	15.7*	41.7	12.6	13.4
Alc-9	18.5*	35.4	9.2	26.2	10.8
Alc-10	19.2*	33.8*	22.3	12.3	12.3
Mean percentages	14.2	43.0	22.3	12.7	7.9
Means for 114 normal subjects	23.2	25.2	21.5	15.9	14.2

* Hallucinated in that modality.

The data obtained from the imagery tests on 10 patients recovered from an alcoholic hallucinosis are presented in table 3. All 10 of these patients had had vivid auditory hallucinations. It will be seen that their mean percentage of auditory imagery is 9.0 lower than that for the normal subject; this difference is highly significant statistically: $t = 6.214$; $P < 0.01$. The mean of the scorable responses for the patients with alcoholic hallucinosis does not differ significantly from that for the normal subjects: $t = 1.926$; $P > 0.05$, indicating that the two groups were equally capable of cooperating in the test. It should be emphasized that the alcoholic patients were completely recovered when they were tested.

The two comparisons made in table 4 demonstrate that the mean percentage of auditory imagery for the patients recovered from an alcoholic hallucinosis is significantly lower than that for the normal subjects; on the other hand, the patients recovered from an alcoholic hallucinosis do not differ significantly from the schizophrenic patients with auditory hallucinations in this respect. These comparisons indicate

even more conclusively that the schizophrenic process, per se, is not responsible for the low percentage of auditory imagery in the schizophrenic patients with auditory hallucinations.

Comparison of the predominating type of schizophrenia with the presence or absence of auditory hallucinations revealed the following relationships: Of the schizophrenic patients with auditory hallucinations, 17 were predominantly paranoid, 1 was hebephrenic and 2 were catatonic; of the schizophrenic patients without auditory hallucinations, 11 were predominantly hebephrenic, 9 were paranoid and none was catatonic.

TABLE 4.—*Comparison of Mean Percentages of Auditory Imagery in Patients with Alcoholic Hallucinosis, Normal Subjects and Schizophrenic Patients with Auditory Hallucinations*

Group	No. of Cases	Mean % Auditory Imagery	σ^m	t	P
Alcoholic hallucinosis	10	14.2	1.379	6.214	<0.01
Normal subjects	114	23.2	0.443		
Alcoholic hallucinosis	10	14.2	1.379	0.0793	>0.05
Schizophrenic patients with auditory hallucinations	20	14.0	1.725		

These results emphasize the fact that auditory hallucinations are far more common in patients with paranoid schizophrenia than in any other type of schizophrenia and that hebephrenic patients are least likely to experience hallucinations in the auditory modality.

QUALITATIVE OBSERVATIONS

The data presented have demonstrated that the schizophrenic patients with auditory hallucinations and the patients who had recovered from alcoholic auditory hallucinations were, in general, characterized by a relative deficiency in their auditory imagery. Some qualitative observations made during the testing of these patients give suggestions regarding the nature of this deficiency, as will be seen in the following examples of their responses to specific test phrases.

CASE AH-2.—Schizophrenic patient with vivid auditory hallucinations; auditory imagery 3.1 per cent.

Stimulus: "Voices of the members of your family."
Response: "I see open lips."
Question: "Can you imagine hearing them?"
Answer: "No. Nothing comes out. Only see the mouths open."

CASE AH-3.—Schizophrenic patient with vivid auditory hallucinations; auditory imagery 5.4 per cent.

Stimulus: "Ringing of telephone."
Response: "I can imagine seeing it, but I can't hear it ring."

CASE AH-8.—Schizophrenic patient with marked auditory hallucinations; auditory imagery 10.8 per cent.

Stimulus: "Striking of a clock."
Response: "It must have stopped. I can't hear it. Just see it."
Stimulus: "Ringing of telephone."
Response: "I see it. I was sitting here waiting for it to ring, but it didn't ring. I could only see it."

CASE Alc-2.—Alcoholic patient recovered from vivid auditory hallucinations; auditory imagery 8.7 per cent.

Stimulus: "Voices of the members of your family."
Response: "I know what they are like, but I can't get a clear effect of the voices. I can't get it in my mind."
Stimulus: "Piano note."
Response: "That means nothing to me. I get no sense whatever. It is hard for me to imagine the sound of things."

CASE NAH-16.—Schizophrenic patient without auditory hallucinations; auditory imagery 30 per cent.

Stimulus: "Striking of a clock."
Response: "Sound. I can hear it so clearly."
Stimulus: "Piano note."
Response: "Hearing. I can hear it so clearly.

The foregoing examples suggest that the patients with auditory hallucinations actually have difficulty in experiencing auditory images, even when they try. This interpretation is supported further by the following two observations:

It was frequently noted in testing the patients with auditory hallucinations that the latent period between test phrase and response was prolonged on those phrases for which auditory responses are usually given. Patients without auditory hallucinations appeared able to bring forth auditory images much more readily.

Furthermore, the patients with auditory hallucinations tended to give nonscorable responses, i. e., associations, definitions and other inadequate responses, only on those tests phrases for which auditory responses are usually given. An association or a definition in response to such a test phrase appeared to represent an attempt by the patient to offer, in lieu of an auditory image, some sort of an answer.

COMMENT

The data presented demonstrate that the mean percentages of auditory imagery for the two groups of patients who had, or had had, auditory hallucinations were significantly lower than those for the two groups of patients who did not have, and had not had, auditory hallucinations. Furthermore, the schizophrenic patients with auditory hallucinations and the patients who had recovered from an alcoholic auditory hallucinosis did not differ significantly with respect to their mean per-

centages of auditory imagery; similarly, the schizophrenic patients without auditory hallucinations and the normal subjects did not differ significantly in this respect.

These findings indicate quite definitely that one of the factors on which auditory hallucinations may depend is a relatively low percentage of auditory imagery. According to this concept, most of those persons who attempt to resolve their personal mental conflicts by projecting them as auditory hallucinations would be found, if they were tested by means of an impersonal projective technic, to have had the hallucinations in a modality of imagery in which they were relatively deficient. This concept implies that relatively deficient auditory imagery is a point of vulnerability and that it is a characteristic of the patient rather than a characteristic of his mental illness.

The problem of conceiving and describing how auditory hallucinations might take place when the auditory imagery is relatively deficient will undoubtedly be much more complicated than it would have been to describe auditory hallucinations as mere exaggerations of an already enhanced and predominating auditory imagery. Therefore, this conceptual and descriptive problem will be deferred to a later occasion, when, in a more general paper, one of us (H. B. M.) will attempt to solve it.

Snyder and Cohen [3] have raised questions concerning "the validity of imagery-testing in schizophrenia"; we feel that those questions are answered by the findings of the present study. The questions they raised cannot be answered by the data presented by them because they presented only selected data, and not all their raw data. We have made a point of presenting all our raw data in tables 1 and 3, so that other investigators will be able to analyze our findings and compare them with the data obtained in their own studies. It should also be emphasized that Snyder and Cohen did not separate visual imagery from auditory imagery, but grouped the two types together as one percentage. We have already pointed out that if the percentage of auditory imagery is low there is usually a compensatory increase in the percentage of visual imagery. Therefore, their method of combining the percentages of auditory and visual imagery may have led to their negative results, just as it would have done in our study had we not kept these two modalities separate. Furthermore, we have already stated that Snyder and Cohen did not study the relationship of mental imagery to hallucinations; they were attempting to distinguish schizophrenic patients from normal subjects in terms of an index of combined auditory and visual imagery.

The conclusion offered by Snyder and Cohen that the imagery test "is not a valid diagnostic criterion of imagery in schizophrenia" was based on the fact that Snyder, on testing and comparing the imagery of schizophrenic patients and normal subjects, failed to find the significant difference between them that Cohen [2] had found. They expressed the

opinion that Cohen's original patients, as a group, were more "disturbed" mentally than the patients tested by Snyder and that this factor was responsible for the significant difference between the percentages of imagery for the schizophrenic patients and the normal subjects in Cohen's investigation. Their descriptions of mentally "disturbed" behavior were, however, so general that we could not use them in classifying our patients. We have already pointed out that our two groups of schizophrenic patients did not differ significantly with respect to cooperativeness, as measured in terms of scorable responses; nevertheless, the mean percentage of auditory imagery for the group with auditory hallucinations was significantly lower than that for the group without auditory hallucinations. Furthermore, the patients who had recovered from alcoholic hallucinosis were not, in any sense of the term, "disturbed" mentally at the time they were tested; yet the mean percentage of auditory imagery for these patients was significantly lower than that for the normal subjects. Since the relationship between relatively low auditory imagery and auditory hallucinations is so obvious in our data, it seems to us that Cohen's original findings were probably due, in large part, not to the fact that his 19 schizophrenic patients were "disturbed" mentally, but to the fact that 18 of them had auditory hallucinations.

SUMMARY

The mental imagery of 40 patients with schizophrenia, 10 patients who had recovered from an alcoholic hallucinosis and 114 normal subjects was tested.

Schizophrenic patients with auditory hallucinations were found to have a significantly lower mean percentage of auditory imagery than either normal subjects or schizophrenic patients without auditory hallucinations. The normal subjects and the schizophrenic patients without auditory hallucinations did not differ significantly in this respect.

Patients who had recovered from alcoholic hallucinosis were found to have a significantly lower mean percentage of auditory imagery than normal subjects. The mean percentages of auditory imagery for patients who had recovered from an alcoholic hallucinosis and for schizophrenic patients with auditory hallucinations did not differ significantly.

Not only do these findings disprove the old theory that auditory hallucinations are exaggerations of predominating auditory imagery, but they suggest the new concept that one of the factors responsible for auditory hallucinations is relatively deficient auditory imagery.

Case Reports

MEDULLOBLASTOMA OF THE CEREBELLUM, WITH SURVIVAL FOR SEVENTEEN YEARS

WILDER PENFIELD, M.D., F.R.S., AND WILLIAM FEINDEL, M.D.
TORONTO, ONTARIO, CANADA

Since the original description of "medulloblastoma cerebelli" by Bailey and Cushing [1] in 1925, this tumor has been generally accepted as a neoplastic entity. It seems to be invariably fatal, in spite of the fact that it is temporarily sensitive to roentgen therapy.

Ingraham and O. T. Bailey [2] have recorded a case of tumor of the cerebellum treated by roentgen irradiation and identified as a medulloblastoma nineteen years after the first symptoms. More recently, Spitz, Shenkin and Grant [3] have pointed out the tendency to longer survival from this tumor in adults. It may therefore be of interest to make brief record of a case in which an adult survived seventeen years after operative removal of a medulloblastoma, the histologic study of which suggested unusually rapid growth.

REPORT OF A CASE

A married woman aged 22 was admitted to the surgical service of the Royal Victoria Hospital on Dec. 16, 1928. She complained of right temporal headache and vomiting for six weeks and blurred vision and diplopia for one week. On admission, she was found to have papilledema of 3 to 4 D. Neurologic examination demonstrated tremor and past pointing in the left hand, pendular knee jerks and absence of the abdominal reflexes. A ventriculogram showed symmetric dilatation of the ventricular system, with no oxygen in the fourth ventricle and none in the subarachnoid space.

Because the history of symptoms was short and the patient had had a series of superficial abscesses for two months, it seemed possible, before the operation, that the lesion of the cerebellum might be an abscess. Suboccipital craniotomy was therefore carried out in such a way as to avoid escape of pus, if found, into the subdural space.

The operative approach was therefore somewhat different. A smaller opening was made and the subdural space walled off. The lesion proved to be a tumor situated in the cerebellum just to the right of the midline and immediately beneath the tentorium. It extended inward to the roof of the fourth ventricle, a depth of 4 to 5 cm. A small incision was made directly over the tumor, and grayish

From the Department of Neurology and Neurosurgery, McGill University, and the Montreal Neurological Institute.

1. Bailey, P., and Cushing, H.: Medulloblastoma Cerebelli, Arch. Neurol. & Psychiat. **14**:192-224 (Aug.) 1925.

2. Ingraham, F. D., and Bailey, O. T.: Cerebellar Medulloblastoma with Verification Nineteen Years After Onset of Symptoms, J. Neurosurg. **1**:252-257 (July) 1944.

3. Spitz, E. B.; Shenkin, H. A.; and Grant, F. C.: Cerebellar Medulloblastoma in Adults, Arch. Neurol. & Psychiat., this issue, p. 417.

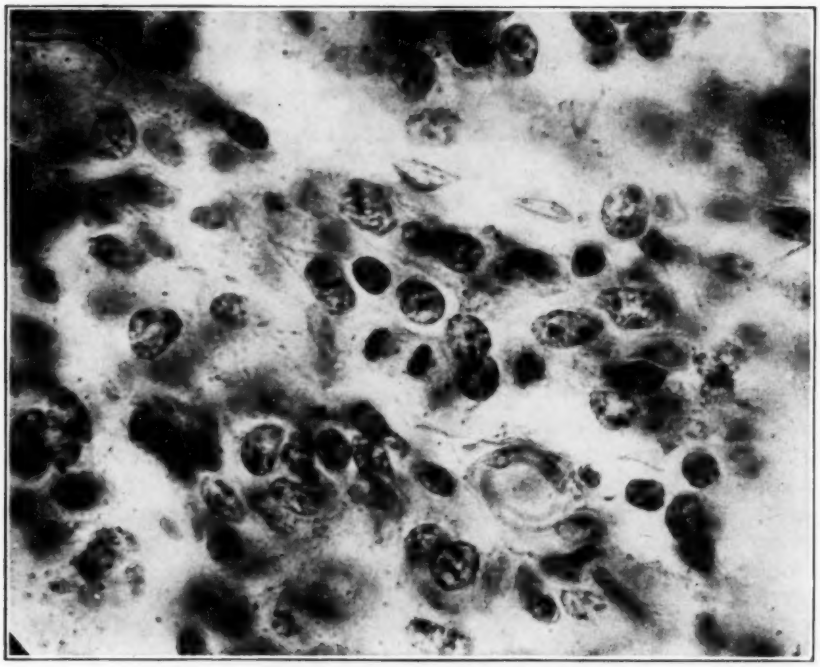

Fig. 1.—Tumor tissue, showing mitotic figures.

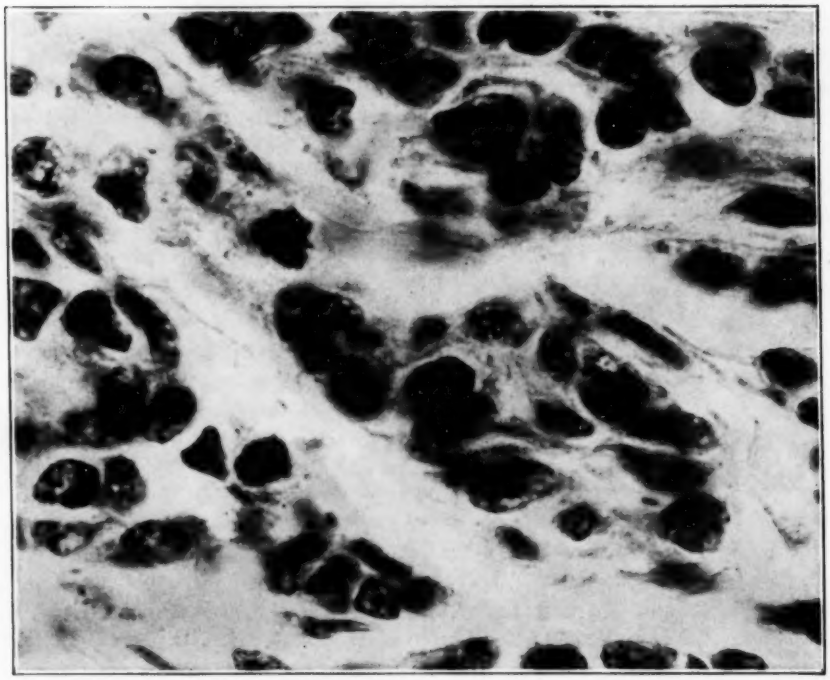

Fig. 2.—Tumor tissue. Note elongation of cytoplasm into short tails. Silver carbonate stain.

yellow neoplastic tissue forced itself out through the opening. The tumor was removed by suction. It contained two moderately firm nodules and was somewhat adherent to the under surface of the tentorium.

Histologic examination of the tissue revealed tumor cells with rounded nuclei. Mitotic figures were numerous (fig. 1). The cell bodies were generally pyriform, the cytoplasm often forming short tails (fig. 2). The cells were arranged in cords between bands of connective tissue, or they appeared as islands surrounded by connective tissue stroma (fig. 3). Not infrequently the cells formed pseudorosettes, as suggested in figure 2.

The material was studied by Dr. William Cone, who made a diagnosis of "medulloblastoma cerebelli" and commented that it seemed to be more rapidly growing than any medulloblastoma he had seen. He added: "The mitotic figures are more numerous and the formation of the cells in columns more striking. There

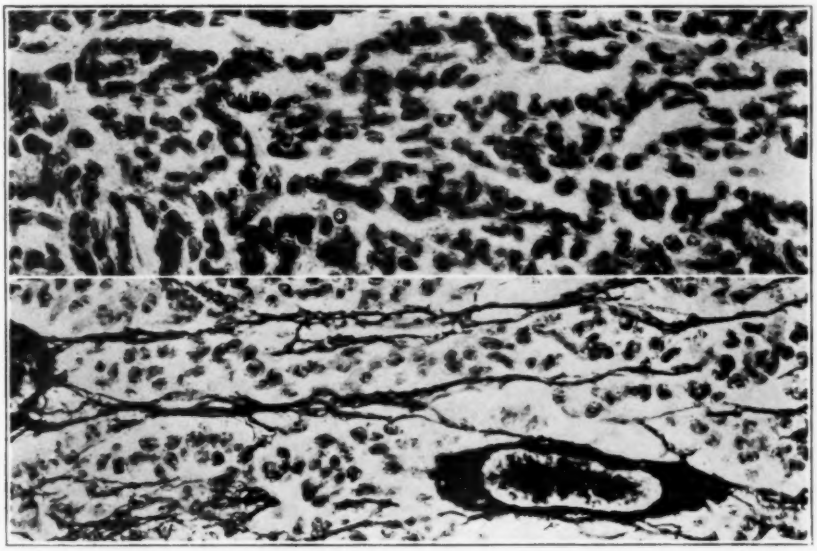

Fig. 3.—Tumor tissue. Above, the nuclear arrangement is shown. Below, the reticulin fibrils are demonstrated in the connective tissue stroma by means of Laidlaw's silver carbonate stain.

are areas, however, where the pseudorosette formation is quite typical of medulloblastoma."

Roentgen therapy was given after operation, although record of the dosage was lost. The papilledema disappeared, and the patient was in good health, working as a housewife and giving birth to a child four and a half years after operation. At the end of nine years she returned with headache and vomiting and was found to have papilledema a second time.

A second suboccipital craniotomy was carried out, but there was no evidence of neoplasm in the cerebellum and the tissue removed proved on microscopic study to be only scarred cerebellum. It was concluded that there had been recurrence of the neoplasm elsewhere in the cranial cavity. Consequently, the patient was given roentgen therapy, in a dose of 3,800 r to the head and 3,500 r to the spine. Again, she recovered and was well until July 1944, sixteen years after her first admission.

At this time she returned with evidence of increased intracranial pressure, disorientation and loss of memory. She was given roentgen therapy again, in a dose of 11,800 r. She recovered a third time, although more slowly.

Before long, however, symptoms recurred, and she died in October 1945, seventeen years after operative removal and roentgenotherapy of the medulloblastoma. The case bears out the suggestion of Spitz, Shenkin and Grant that adults have a higher degree of resistance to the recurrence of this tumor than children.

Summary.—In this case, a medulloblastoma of the cerebellum made its appearance when the patient was 22 years of age. There was recurrence of symptoms after nine years, and again after sixteen years. In the first (and probably the second) instance, the recurrence was at a distance from the cerebellum, and in each the result of roentgen therapy was initially satisfactory. Although the histologic appearance suggested a high degree of malignancy, there was useful and happy survival for seventeen years.

3801 University Street.

News and Comment

PAUL B. HOEBER, INC., PUBLISHERS OF PSYCHOSOMATIC MEDICINE

Psychosomatic Medicine, the bimonthly journal sponsored by the American Society for Research in Psychosomatic Problems, Inc., was founded in 1939, with the assistance of the Josiah Macy Jr. Foundation, and was sponsored during its first five years of publication by a division of the National Research Council. Beginning with the issue for January-February, 1947, it will be published by Paul B. Hoeber, Inc., Medical Book Department of Harper & Brothers, New York. Dr. Flanders Dunbar, of New York, is editor in chief of the journal, and Dr. Edward Weiss, of Philadelphia, is president of the society for the current year.

The subscription price of the journal is $6.50 per year. Existing volumes in the series, *"Psychosomatic Medicine Monographs,"* published by the society, will hereafter be distributed by Paul B. Hoeber, Inc.

PORTLAND (ORE.) CHILD GUIDANCE CLINIC

Notice is given that the city of Portland (Ore.) is establishing a full time community child guidance clinic. This clinic is to have financial backing of the community chest and a number of other interested agencies in the community. At present there is an opening for a full time psychiatrist and clinical director of that clinic, with a salary between $10,000 and $12,000 a year, depending on the qualifications. Further information may be obtained from the Board of Community Child Guidance Clinic. The address is c/o Council of Social Agencies, The Terminal Building, Twelfth and S. W. Morrison, Portland, Ore.

Abstracts from Current Literature

EDITED BY DR. BERNARD J. ALPERS

Physiology and Biochemistry

CHOLINESTERASES IN SYMPATHETIC FIBERS AND GANGLIA. CHARLES H. SAWYER and W. HENRY HOLLINSHEAD, J. Neurophysiol. **8**:137 (May) 1945.

Sawyer and Hollinshead studied by means of a microchemical method the cholinesterases of the cat's peripheral nerve fibers and ganglia. A wide distribution of both true and pseudocholinesterase was found. Both esterases were present in strong, practically equal, concentrations in the superior cervical ganglia, and both were most active in the region where preganglionic endings and ganglion cells were most concentrated. In the cervical portion of the sympathetic trunk most of the hydrolysis of acetylcholine was found to be performed by true cholinesterase. After preganglionic section true cholinesterase is lost at the same rate by the ganglion and by the degenerating preganglionic fibers. This observation was interpreted as indicating that the common elements of these structures, namely, preganglionic axons and endings, produce the enzyme. Pseudocholinesterase is lost at a much slower rate than is true cholinesterase, indicating its production by an intrinsic element, probably the ganglion cells. Stripping the ganglion resulted in chromatolysis and disappearance of the preganglionic endings. This was associated with total disappearance of true cholinesterase and decrease in the pseudocholinesterase. Sawyer and Hollinshead conclude that these observations emphasize the importance of true cholinesterase in synaptic transmission and minimize the physiologic importance of pseudocholinesterase.

FORSTER, Philadelphia.

CHANGES IN BRAIN POTENTIALS DURING CONVULSIONS INDUCED BY OXYGEN UNDER PRESSURE. ROBERT COHN and ISIDORE GERSH, J. Neurophysiol. **8**:155 (May) 1945.

Cohn and Gersh studied the electrical activity of the cortex of cats exposed to oxygen under increased pressure. Within one to two minutes after exposure to oxygen under pressure the normal cortical rhythm was interrupted by bursts of slow activity, which became prominent after six and a half minutes and one-half minute later were followed by convulsions and high voltage fast, spiking activity. The authors concluded that the pattern of the brain waves during the convulsions of oxygen poisoning in the cat resembles that observed with other well defined clinical and experimentally induced seizures. Present evidence indicates that a similar pattern would result in human subjects if experiments were to progress to the phase of motor discharge. The data are consistent with the concept that the seizure is the result of interference with basic intracellular, perhaps enzymatic, activity.

FORSTER, Philadelphia.

ELECTROENCEPHALOGRAPHIC CHANGES FOLLOWING HEAD INJURIES IN DOGS. ROBERT S. DOW, GEORGE ULETT and ARCHIE TUNTURI, J. Neurophysiol. **8**:161 (May) 1945.

Dow, Ulett and Tunturi report the electroencephalographic changes induced in dogs by head injuries. Trauma was produced by a pendulum with a rigid hitting arm, and the animals were so muzzled and fastened as to decelerate the head after it had traveled 6 to 8 inches (15 to 19 cm.). The authors found that dogs are

less susceptible to impacts delivered to the freely moving head than are cats. The effects of impact are greater when the animal is under general than when under local anesthesia. The spindles of high voltage activity, which are characteristic of the records of animals anesthetized with barbiturates, were most susceptible to the effects of trauma. Head injuries affected correct conditioned differentiation to a greater degree and for a longer time than they affected reflex activity and more vital functions. Correct conditioned differentiation appeared to be a more delicate index of cortical function than the electroencephalogram. Dow, Ulett and Tunturi concluded that the evidence indicates that concussion has a direct paralyzing effect of temporary character, independent and beyond any mechanical stimulation of neurons.

FORSTER, Philadelphia.

SENSORY-MOTOR NERVE CROSSES IN THE RAT. PAUL WEISS and MAC V. EDDS JR., J. Neurophysiol. **8**:173 (May) 1945.

Weiss and Edds reexamined the problem of regeneration of sensory nerve fibers into motor stumps and muscles. Arterial sleeves were employed to effect the crosses. The sensory fibers regenerated into and through the motor nerve with ease and passed the motor point. They pervaded the muscle with a rich network of arborizations and exhibited no sign of selectivity in their regeneration. After regeneration occurred, electrical stimulation of the crossed nerve in most cases yielded a motor response. Stimulation of ventral and posterior roots separately, and stimulation of the peripheral nerve after degeneration of motor fibers following section of the ventral root, revealed that the motor responses depended on the ventral root fibers included in the cross. Atrophy and degeneration occur despite the presence of sensory fibers around muscle fibers. Sensory fibers, therefore, do not affect the trophic condition of the muscle. Weiss and Edds concluded that the failure of sensory fibers to transmit motor impulses could be ascribed to lack of proper structural connection, to biochemical incompatibility or to lack of a mediator of physiologic impulses. There was no histologic evidence of resorption of functionally useless sensory fibers in motor pathways. Muscles with mixed reinnervation demonstrate a disproportionately increased gain in weight. Histologically innervated fiber groups are rather sharply set off from degenerated groups. Earlier reports of motor innervation by sensory nerves can be attributed to the presence of stray motor fibers.

FORSTER, Philadelphia.

THE EFFECT OF ANTICONVULSANT DRUGS ON RECOVERY OF FUNCTION FOLLOWING CEREBRAL CORTICAL LESIONS. CHARLES WESLEY WATSON and MARGARET A. KENNARD, J. Neurophysiol. **8**:221 (July) 1945.

Since certain stimulants produce a beneficial effect on the rate and degree of recovery of motor function in Macaques (Macaca mulatta) from which the motor cortex has been ablated, Fulton and Watson studied the effects of sedatives in the same type of preparation. The motor and premotor areas were ablated from one hemisphere. Two animals were used as controls; 3 received phenobarbital sodium; 1, carbaminoylcholine and atropine; 2, diphenylhydantoin, carbaminoylcholine and atropine, and 1, diphenylhydantoin alone. Both clinical and electroencephalographic observations were made. Watson and Kennard found that prolonged, subhypnotic administration of phenobarbital sodium decreased the rate of recovery of the animals. The enhanced rate of recovery induced by carbaminoylcholine was prevented by the administration of diphenylhydantoin. It did not seem that the latter alone, however, altered significantly the rate of recovery. The electroencephalograms were not affected by diphenylhydantoin or carbaminoylcholine and atropine.

FORSTER, Philadelphia.

CREATINE METABOLISM IN RELATION TO PITUITARY TUMOURS. J. N. CUMINGS, Brain **67**:265, 1944.

Cumings determined the creatine and creatinine contents of the urine of 8 patients with chromophobic adenomas and of 16 patients with acidophilic adenomas

of the pituitary gland. All patients with chromophobic adenoma showed a normal or slightly increased excretion of creatinine and on some days small amounts of creatine. There was no postoperative alteration in these values. In the cases of acromegaly Cumings observed a definite excretion of creatine and an increased quantity of creatinine in the urine. Cumings concludes that in the absence of thyrotoxicosis urinary excretion of creatine is sufficient to distinguish between the two types of adenoma of the pituitary gland. A creatine tolerance test was devised, consisting of the administration of 1 Gm. of creatine to a fasting patient and determination of the creatine and creatinine contents of the blood and urine. With this method, it was possible to distinguish between the two types of tumors of the pituitary and also to differentiate between dysfunction of the pituitary and the thyroid gland.

FORSTER, Philadelphia.

Psychiatry and Psychopathology

DEFINITION OF PSYCHOPATHIC PERSONALITY. HARRY F. DARLING, J. Nerv. & Ment. Dis. **101**:121 (Feb.) 1945.

Darling lists the characteristics of the psychopathic personality as given by various authorities and offers as a definition of the condition the following statement: "Psychopathic personality may be defined as a mental disease which develops before or during puberty, caused by inherited predisposition, or by acquired personality deviation due to psychic or somatic factors or both, which, in turn, cause super-ego deficiency; it is characterized by stereotyped deviations in the moral, social, sexual and emotional components of the personality, without intellectual impairment, psychosis, or neurosis, with lack of more than insight or ability to profit by experience, and is of lifelong duration in almost all cases."

CHODOFF, Washington, D. C.

PSYCHOSOMATIC ASPECTS OF STUTTERING. BERNARD C. MEYER, J. Nerv. & Ment. Dis. **101**:127 (Feb.) 1945.

In an effort to clarify some of the controversial aspects of the problem of stuttering, Meyer studied 116 stutterers at the National Hospital for Speech Disorders in New York city from the point of view of the family history and the physical, neurologic and psychiatric status.

Stuttering occurred nearly ten times as frequently in the families of stutterers as in the families of nonstutterers, but the distribution of the disorder did not appear to follow any clearcut, simple mendelian pattern of heredity. In most cases it was not possible to rule out imitation or other nonhereditary factors as responsible for the frequency of familial stuttering. The possibility exists that a tendency to stutter may be part of a complex hereditary pattern.

The neurologic examination failed to reveal consistent evidence of disease of the nervous system except for the rather frequent finding of inequality in the arm swing while walking. The significance of this phenomenon is unknown. Physical examination failed to show evidence of constitutional inferiority or organic disease in a significant number of cases. The most frequently observed abnormalities included moist hands and feet, dilated pupils, hyperactivity of the deep tendon reflexes and vasomotor disturbances of the skin. These findings were considered typical of the state of chronic anxiety, and not characteristic of stutterers alone.

From a study of the handedness and eyedness of the subjects, the author concludes that in more than three fourths of the total number of stutterers studied there was no evidence for the assumption that a dominant cerebral hemisphere had not been established.

Psychiatric investigation revealed that the stutterer is often a schizoid person who displays other disorders than stuttering. Many of the subjects gave a history of bed wetting, nail biting and nightmares. Analysis of the onset of the stutter revealed that in nearly half the cases a specific etiologic agent, such as fright,

trauma, enforced shift of handedness, imitation, illness or surgical operation, was present. The subsequent history of the stutter demonstrated the close association between emotion and the speech disorder.

The author believes that stuttering should be regarded as a single manifestation of a more general neurotic problem and that it represents the resultant of the conscious will to express oneself, on the one hand, and an unconscious inhibition of speech, on the other. The latter appears to serve as a defense against anxiety.

CHODOFF, Washington, D. C.

HEALING MECHANISMS IN THE SHOCK TREATED NEUROTIC PATIENT. JOHN D. MORIARTY and ANDRÉ A. WEIL, J. Nerv. & Ment. Dis. **101**:205 (March) 1945.

Moriarty and Weil previously described a new method of treatment of the neuroses, consisting of a combination of convulsive therapy and psychotherapy. With the addition of more patients and as follow-up studies became more extensive, they were able to gain further insight into the interplay of healing mechanisms. They believe that the treatment of the neurotic patient must have a broad basis, which includes various psychosomatic relationships. Many so-called anxiety neuroses, tension states and gastrointestinal and cardiac neuroses are associated with definite physiologic disturbances, which sometimes progress to the point of demonstrable structural change. More specifically, the regulatory mechanisms of the central nervous system are widely disturbed, with special repercussions in the function of the vegetative nervous system. Since shock therapy seems to have an almost specific influence on these regulatory mechanisms, it appears logical to employ it.

The authors have treated 42 neurotic patients, first using metrazol but later changing to electric shock. For the latter they use an apparatus which delivers a unidirectional current, small doses of which are sufficient to produce a convulsion. Usually three to six electric shock treatments have been sufficient. In 16 patients (38 per cent) remissions were produced, while there was improvement in 23 patients (55 per cent) and no change in 3 patients (7 per cent).

The healing mechanisms are based on an interplay of physiologic, psychobiologic and psychologic factors. The physiologic effect is achieved through the stabilizing effect of the shock therapy on the regulatory centers of the central system, especially the hypothalamus. Concomitantly, there occurs reestablishment of previously neurotically inhibited reflex responses, with the disappearance of such symptoms as insomnia, tension and depression. From a psychobiologic viewpoint, convulsive therapy seems to operate by the activation of a deep, primitive "lower level fear." There may be a similarity between the unconscious development of abnormal psychic mechanisms as an escape from life situations and the rejection of these when an apparently fundamental threat to existence makes it better to reject than to retain them. Psychologic healing factors include the development of courage and self confidence and the improvement of morale through the increased operation of the "herd instinct." Psychotherapy is facilitated through a promotion of the state of transference, a setting free of the patient's energy and overcoming of libidinous fixation.

CHODOFF, Washington, D. C.

PATHOLOGICAL WEEPING. PHYLLIS GREENACRE, Psychoanalyt. Quart. **14**:62, 1945.

Two types of neurotic weeping are found in the analysis of women patients—shower weeping and stream weeping. In the former, there are copious tears with little provocation and without much sobbing and crying. In the latter, little obvious emotion is evident, but a stream or trickle of tears rolls down the cheek when certain sensitive, deeply repressed subjects are touched in the analytic work. In both, a strong element of exhibitionism together with marked penis envy and some visual fascination based on urination is present. Shower weeping indicates some acceptance of the female role but a rather discouraged attitude about it. This

type weeps in anger and in partial resignation because she cannot approximate male urination. Stream weeping is a substitute for male urination, the penis envy appearing in periodic aggressive demands for the male organ, accompanied with fantasies for its possession. An extreme body-phallus identification may always be present in stream weepers. The author cites 2 cases in support of her thesis. She wonders whether the extravasation of water from the body, whether it appears as a channeled excretory process (as in lacrimation, sweating and urination) or as a local or general transudative edema resulting from severe or prolonged nonspecific traumas, is not basically an expression of aggressive defense.

PEARSON, Philadelphia.

CORNELL SERVICE INDEX: A METHOD FOR QUICKLY ASSAYING PERSONALITY AND PSYCHOSOMATIC DISTURBANCES IN MEN IN THE ARMED FORCES. ARTHUR WEIDER, KEEVE BRODMAN, BELA MITTELMAN, DAVID WECHSLER and HAROLD G. WOLFF, War Med. **7**:209 (April) 1945.

The Cornell Service Index is a simple device for obtaining and evaluating data of military psychiatric significance. It is essentially an anamnesis with quantitative features. It is self administered and may be given to many subjects simultaneously. It can be completed in ten minutes and scored within one minute.

The least disturbing questions are placed at the beginning of each group and the least disturbing groups at the beginning of the form: The order in which the groups appear in the Index is as follows: (*a*) Questions 1 through 3 are introductory and neutral; (*b*) questions 4 through 17 concern defects in adjustment to military groups, expressed as feelings of fear and inadequacy; (*c*) questions 18 through 20 and 24 through 30 concern pathologic mood reactions, especially anxiety and depression; (*d*) questions 21 through 23 concern neurocirculatory psychosomatic symptoms; (*e*) questions 31 through 37 concern pathologic startle reactions; (*f*) questions 38 through 49 concern a variety of other psychosomatic symptoms; (*g*) questions 50 through 63 concern hypochondriasis and asthenia; (*h*) questions 64 through 74 concern gastrointestinal psychosomatic symptoms; (*i*) questions 75 to 79 concern excessive sensitivity and pathologic suspiciousness, and (*j*) questions 80 through 92 concern symptoms of troublesome psychopathy.

By means of the Index score, a sharp differentiation can be made between persons with little or no psychoneurosis and those in whom psychoneurosis interferes or may interfere seriously with military performance. Ninety-eight per cent of persons with severe psychoneuroses are detected, while 3.5 per cent of ostensibly healthy persons are found to have poor scores.

PEARSON, Philadelphia.

CORNELL SERVICE INDEX: REPORT ON ITS USE IN THE EVALUATION OF PSYCHIATRIC PROBLEMS IN A NAVAL HOSPITAL. NATHANIEL WARNER and MARGARET WILSON GALLICO, War Med. **7**:214 (April) 1945.

Warner and Gallico used the Cornell Service Index in the scoring of 1,300 patients and found that the responses obtained distinguished with a high degree of accuracy patients without apparent personality disturbances from those who presented psychiatric complaints of significant degree. The form does not effect a very clear separation between mild and severe personality disturbances, though it is of some help in this differentiation.

It reveals a small number of persons with histories replete with psychoneurotic symptoms who are not thereby prevented from performing their duties adequately. Part of the explanation of this apparent discrepancy lies in the factor of motivation toward the service.

The form does not reveal adequately the histories of subjects who are lacking in awareness of their difficulties. It does not cover many cases of conversion hysteria, and it does not concern itself with sexual disturbances. It does apply adequately to the great majority of patients who come to the attention of the military psychiatrist, and it should prove to be of considerable use in the evaluation of psychiatric disturbances in the members of the armed services.

PEARSON, Philadelphia.

SUBACUTE EMOTIONAL DISTURBANCES INDUCED BY COMBAT. R. A. COHEN and J. G. DELANO, War Med. **7**:284 (May) 1945.

The majority of patients with subacute emotional disturbances induced by combat presented in common the syndrome of anxiety, heightened irritability, startle reaction and catastrophic nightmares. They showed also a great variety of neurotic disturbances, based on individual life experiences. The more chronically ill showed a narrowing of the range of activities and interests, attitudes of dependence and need for esteem, thinly veiled by aggressive combativeness. A failure of the fight or flight reaction to danger seems to give rise to this syndrome.

Treatment is based on an understanding of the dynamics of each case. A balanced program of education, recreation and work under planned organization and leadership gives a purposeful direction to the daily activities. Group therapy is particularly effective in reenforcing certain psychologic mechanisms which serve to control anxiety, restore the patient's initiative and promote a better adjustment to military life.

The two most important factors in rehabilitation appear to be, first, restoration of the patient's self esteem and resolution of some of his anxiety by individual and group psychotherapy and, second, promotion of his reintegration with the group so that he may regain the important controls over untoward emotional reactions which identification with the group affords.

PEARSON, Philadelphia.

FUNCTIONAL ENURESIS IN THE ARMY: REPORT OF A CLINICAL STUDY OF ONE HUNDRED CASES. HERMAN SHLIONSKY, LOUIE R. SARRACINO and LEDFORD J. BISCHOF, War Med. **7**:297 (May) 1945.

A clinical neuropsychiatric study was made of 100 men with functional nocturnal enuresis. A high incidence of enuresis was found in the immediate members of their families. The educational and occupational background of the group was below average. A relatively high percentage were below the average in intelligence. There was no evidence of mild or arrested forms of myelodysplasia. The vast majority of the men had various neurotic tendencies and personality disorders. Most showed emotional immaturity, dependence and a passive type of personality. Functional backache was common. The symptom of enuresis in itself creates a difficult situation in the service, but this study shows that the large majority of enuretic adults do not possess emotional or intellectual qualifications for the armed services.

PEARSON, Philadelphia.

CAMPTOCORMIA: A FUNCTIONAL CONDITION OF THE BACK IN THE NEUROTIC SOLDIER. S. A. SANDLER, War Med. **8**:36 (July) 1945.

Camptocormia is an hysterical phenomenon manifested by pain in the lumbar region and by a bent trunk. The onset of this back-bending phenomenon is concomitant with or preceded by impotentia, which is probably indicative of the soldier's latent homosexuality and castration anxiety.

In this syndrome there is not only the adoration of, but a suppressed ambivalent irritability and hostility against, the father. There is present a strong overidentification with the father, who generally has also had trouble with his back. The ambivalent feeling toward the father reflects itself toward authority in the military situation, with resulting projection of resentment on commissioned and noncommissioned officers. The military situation is the source of constant threat and danger to the ego, which continually strives for its safety and protection. When the pressure becomes too great, the ego wilts and the symptoms of camptocormia develop.

PEARSON, Philadelphia.

Diseases of the Brain

ELECTROENCEPHALOGRAPHIC STUDIES IMMEDIATELY FOLLOWING HEAD INJURY. R. DOW, G. ULETT and J. RAAF, Am. J. Psychiat. **101**:174 (Sept.) 1944.

Dow, Ulett and Raaf studied the electroencephalograms of 197 patients with mild head injuries. The time interval between injury and the electroencephalo-

graphic study was seldom less than several hours, and the shortest interval was ten minutes. In this group, 173 men and 24 women were used; their ages ranged from 16 to 87 years. As controls, studies were made on 211 persons, ranging in age from 17 to 77 years. Of the 197 patients studied, 187 had lacerations or contusions of the head. Fifty-four of the 197 patients and 70 of the control series gave a history of a blow on the head. In the injured series, the electroencephalographic records showed no greater abnormality than the records of the subjects who had not sustained a previous injury.

The encephalographic unit consisted of a push-pull amplifier with a three channel, ink-writing oscillograph, Grass type. A cubicle was erected to eliminate the outside electrical interference. A head band electrode holder with six spring pressure controls was used instead of the six electrodes sealed with collodion.

From their studies, Dow, Ulett and Raaf draw the following conclusions: 1. Abnormality of the electroencephalogram as a result of mild cerebral trauma disappears within a few minutes. 2. Patients with amnesia following cerebral trauma showed only a slightly greater percentage of abnormal records than the control series even if the records were taken within a few hours of the accident. 3. Abnormality in the electroencephalogram was present if there was impairment of consciousness of any degree at the time of the recording. 4. Electroencephalograms taken within thirty minutes after head injuries displayed a greater percentage of abnormality than those taken after a thirty minute lapse. 5. The average velocity of the striking object or falling head was less than the velocity necessary to produce concussion in experimental animals. 6. The study of electroencephalogram records taken immediately after mild head injury was less reliable than clinical judgment in predicting loss of time from work.

The authors assert that the rapid disappearance of electroencephalographic abnormalities indicates the presence of some mechanism in concussion other than petechial hemorrhage, cerebral contusion, embolic phenomenon or any other histopathologic change which must require several days to disappear.

BORKOWSKI, Philadelphia.

IDEOKINETIC APRAXIA FOLLOWING PARTIAL RECOVERY FROM VISUAL AGNOSIA: REPORT OF A CASE WITH AUTOPSY. GEORGE N. THOMPSON, Bull. Los Angeles Neurol. Soc. **10**:70 (March-June) 1945.

Thompson reports the case of a married white woman aged 59 who entered the hospital in coma. Two years prior to admission she had had an episode of loss of consciousness, from which she recovered within several hours. She was confused for several weeks, and this symptom subsided. She was then fairly well oriented and mentally clear, except that she had some trouble with figures. She found it difficult and confusing to deal with her ration books and could not be troubled with her bank account. For the next two years she had visual agnosia, alexia and agraphia, with partial recovery.

Eighteen days prior to admission to the hospital she had what appeared to be "another stroke." After this episode ideokinetic apraxia developed, and this persisted. The patient died the day after her admission to the hospital.

At necropsy two vascular lesions were observed in the left hemisphere. One lesion involved exactly the area of the supramarginal gyrus; the other, the entire posterior parieto-occipital region, with its center occupying area 19 of Broadmann. Section revealed that the thrombotic softening in area 19 extended into area 18. A small lesion in the right occipital lobe in areas 17 and 18 of Broadmann was observed A section made 1.5 cm. higher than the first showed the softening already described, as well as pronounced atrophy of the lesion centered in the area 19 of Broadmann on the left hemisphere. It is of interest to note that there was no hemiplegia. After development of apraxia there was strong unilateral dominance for motor acts. On the other hand, however, cerebral dominance for eugnosia was not marked, as a few weeks after the lesion causing visual agnosia occurred the function of eugnosia reappeared. The transfer of revisualization,

except for symbols, because of interruption of connections to the major angular gyrus, was effected well. This case, then, was one of strong parietal cerebral dominance but weak occipital cerebral dominance, and it represents, according to the author, a deviation from the general rule that unilateral cerebral dominance for motor acts is less marked than that for eugnosia. GUTTMAN, Philadelphia.

A CASE OF "CENTRAL DIABETES MELLITUS." F. R. WOODWARD, Bull. Los Angeles Neurol. Soc. **10**:78 (March-June) 1945.

Woodward reports the case of a woman aged 50 who was admitted to the hospital after an acute attack of headache, vomiting, loss of consciousness and involuntary micturition. For some time the patient had had polyphagia and polydipsia. She had numbness of the hands and a sensation as though one of her fingers did not belong to her. For three weeks prior to the acute episode she complained of a severe headache, specifically, an intense pain behind the left ear. About eight months prior to her current difficulties she was told by a physician that she had high blood pressure.

At the time of admission the patient was in a deep coma, with a blood pressure of 236 systolic and 130 diastolic. Significant features on examination were small round pupils, which were fixed in reaction to light; hemorrhages in the periphery of both fundi; absence of deep reflexes, except for normal responses in the left upper limb; Babinski and Oppenheim reflexes on the left side, and rigidity of the neck and the Brudzinski sign.

The urine gave a strongly positive reaction for sugar. The blood sugar measured 305 mg. per hundred cubic centimeters. The carbon dioxide–combining power of the blood was 32 volumes per cent. The spinal fluid was under a pressure of 550 mm. of the fluid, and it was grossly bloody.

The following morning the patient could be aroused somewhat, and hemianopsia was suspected. Right hemiplegia seemed to be developing. It was thought that she had a primary intracerebral and secondary subarachnoid hemorrhage. Three days after admission the patient died.

Examination of the brain revealed only one lesion, a large saccular aneurysm in the third ventricle. This had ruptured.

Woodward states that the syndrome of diabetes mellitus with normal carbon dioxide–combining power of the blood leads one to suspect a lesion about the third ventricle of the brain. In the case here reported, the patient had severe hypertension but was able to carry on her profession until a few months before she died of a "ruptured aneurysm of the circle of Willis." The clinical diabetes was terminated by a classic syndrome of rupture of the aneurysm.

GUTTMAN, Philadelphia.

NEURO-OPTIC MYELITIS: A CLINICOPATHOLOGICAL STUDY OF TWO RELATED CASES. HEINZ KOHUT and RICHARD B. RICHTER, J. Nerv. & Ment. Dis. **101**:99 (Feb.) 1945.

Kohut and Richter review the literature on neuro-optic myelitis, emphasizing the controversial position of the syndrome, especially in its relation to acute multiple sclerosis and disseminated encephalomyelitis. Two cases of the condition are reported. The first was that of a white man aged 59 in whom there gradually developed ascending myelitis with a transverse lesion of the cord at about the level of the third dorsal segment and then, while he was still hospitalized, bilateral optic neuritis, which later cleared up. There were no other signs of neurologic damage. The second case was that of a white woman aged 43 who, after acute pharyngitis, had acute bilateral optic neuritis associated with symptoms and signs of ascending myelitis and died on the twelfth day in the hospital. Autopsy was performed, and pathologic study revealed diffuse necrosis of the medulla and spinal cord, characterized by demyelination, destruction of nerve fibers, foci of softening, hemorrhage, status spongiosus, increase in microglia cells and innumerable gitter cells.

There was severe, diffuse retrobulbar neuritis, with demyelination, destruction of nerve fibers, presence of hypertrophic astrocytes and increase in microglia cells, with formation of gitter cells.

The authors assert that the distinctive nature of the 2 cases reported and the absence of dissemination justify placing them in a category of their own. This concept is supported by the pathologic observations in case 2, which do not conform in any way to even the broadest pathologic concept of multiple sclerosis or disseminated encephalomyelitis. Diffuse, massive necrosis of the spinal cord, acute degeneration of the optic nerves and complete absence of dissemination elsewhere in the central nervous system constitute a pathologic complex *sui generis*. The authors feel that neuro-optic myelitis should be considered as a clinicopathologic syndrome, within the broad group of acute toxic and toxi-infectious degenerations of the nervous system.

CHODOFF, Washington, D. C.

TRAUMATIC PNEUMOCEPHALUS. L. H. GARLAND and M. E. MOTTRAM, Radiology **44**:237 (March) 1945.

Garland and Mottram report a case of traumatic pneumocephalus occurring in a man aged 28 nine weeks after attempted suicide. The bullet entered the right temporal region and produced immediate and permanent blindness of the right eye. Nine weeks later headache, vomiting and drainage of spinal fluid from the nose developed A roentgenogram showed air in the lateral, third and fourth ventricles and in the right frontal area, in the region of the fracture through the anterior fossa. Complete symptomatic recovery followed rest in bed, and roentgenograms made ten days later showed only a trace of residual air in the ventricles. Undoubtedly, the air entered the brain through the fractured frontal and ethmoidal sinuses.

The vast majority of pneumoceles are the result of fractures of sinuses or mastoid, with the air entering the brain as a result of increased pressure (coughing, sneezing or blowing the nose) or the ball valve action of a piece of tissue or bone. The collection of air may occur within a week after injury or may be delayed as long as ten months. The usual interval before recognition is about one month. The reason for the latent period is unknown.

The symptoms of pneumocephalus may be mild, but there is usually some irritation of the central nervous system, often associated with meningismus or signs of increased intracranial pressure. Without roentgenologic studies, an incorrect diagnosis of cerebral abscess, subdural hemorrhage or meningitis may be made. The mortality is about 40 per cent, with death usually due to meningitis.

TEPLICK, Washington, D. C.

ENCEPHALITIS AND TRAUMA. J. O. TRELLES, Rev. de neuro-psiquiat. **7**:361, 1944.

A merchant aged 42 was assaulted and thrown to the ground, sustaining a head injury, with loss of consciousness for a short, but undetermined, period and ecchymoses around the eyelids. Except for occipital headache for a few days, there were no postconcussional complaints. Six weeks later he suddenly became dizzy, complained of occipital headache and became dull and somnolent. Two weeks after this, right hemiplegia developed, with hyperreflexia and a positive Babinski sign, associated with lethargy, torpidity and dysarthria. He was indifferent and confused, yawned frequently and had attacks of paroxysmal laughing and crying. His pulse rate was 56. The urine was normal; urea nitrogen measured 37 mg. per hundred cubic centimeters, and the white blood cell count was 12,600, with 77 per cent polymorphonuclear cells. A few days later the white blood cell count was 8,600, with 76 per cent polymorphonuclear cells. Examination of the spinal fluid on April 30 showed 13 lymphocytes, 97 mg. of glucose and 644 mg. of chlorides per hundred cubic centimeters; the Pandy test gave a negative reaction for globulin, and the Wassermann reaction of the spinal fluid was negative. The fundi showed blurred edges of the disk and dilated veins. There was progressive improvement, and the patient was considered recovered after four months. The clinical picture

was that of encephalitis. On admission, because of the recent history of head trauma, the possibility of a subdural hematoma was considered. The author believes that the trauma created a locus minoris resistentiae in the brain and predisposed to localization of the virus.

SAVITSKY, New York.

Diseases of the Spinal Cord

ABDUCENS PALSY (WITH SUBSEQUENT RECOVERY) FOLLOWING LUMBAR PUNCTURE. HARRY M. ROBINSON JR., Am. J. Syph., Gonor. & Ven. Dis. **29**:422 (July) 1945

Robinson reports his observations on a man aged 26 who was subjected to lumbar puncture toward the end of a course of antisyphilitic treatment. The following day he experienced dizziness and severe pain at the site of puncture. The pain, which originated in the lower part of the back, seemed to shoot up to the neck and the back of the head. On the following morning he could not stand without fainting.

Five days after lumbar puncture diplopia developed. He had partial paralysis of the right abducens nerve, with almost complete strabismus of the right eye. Two days later the paralysis of the right sixth nerve was complete. Complete neurologic examination revealed nothing unusual except for involvement of the abducens nerve. About twenty-seven days after lumbar puncture some lateral motion in the right eye was present. Steady improvement followed. There was complete return of function about two months after the lumbar puncture.

GUTTMAN, Philadelphia.

TRANSMISSION OF POLIOMYELITIS BY PATIENT TO PATIENT CONTACT. A. E. CASEY and W. I. FISHBEIN, J. A. M. A. **129**:1141 (Dec. 22) 1945.

Casey and Fishbein, in their study of transmission of poliomyelitis by patient to patient contact, found that of 66 persons in contact with patients with poliomyelitis during the infectious period, 37 had illnesses within six to fifteen days afterward which were compatible with poliomyelitis. Of 109 other children of the same age who resided within the same block as the patient but who had not been in contact with the patient during the infectious period, 4 had illnesses compatible with poliomyelitis, and not 1 had a classic case.

Of 115 control children of the same age as the contacts and noncontacts but who lived ten and fifty blocks distant from the poliomyelitis patients' neighborhood and were apparently without contact with a clinical case, 5 had illnesses compatible with poliomyelitis, and not 1 had a clinical case. There was no statistically significant difference between the noncontacts and the controls in this respect, but there was a highly significant difference between these two groups and the contact group.

The authors came to the following conclusions: Multiple cases of poliomyelitis in the family were the rule rather than the exception when there were other children from 1½ to 8½ years of age in the home. 2. Poliomyelitis was found to be contagious perhaps to the degree of 90 per cent in the 1½ to 3½ year age group but was less so in the older groups. 3. There was no evidence that flies and other insects played a major role in the spread of the disease in the neighborhoods studied, once the disease had been introduced. 4. Only about 1½ out of 6 cases of poliomyelitis would have been diagnosed as such, even under an alert public health reporting system, without an intensive neighborhood study. Illness in the other cases of poliomyelitis was generally so mild that a physician was not consulted. 5. Paralysis developed in about 1 case in 6, and in about 2 cases in 6 the diagnosis could be confirmed only by animal inoculations or by determination of the protein content of the spinal fluid two to seven weeks after onset. 6. Poliomyelitis in the cases studied was usually very mild, but in every instance there was sufficient systemic disturbance to account for thorough immunization. Even

in the mildest cases the protein of the spinal fluid was above 45 mg. per hundred cubic centimeters two to six weeks after onset. 7. Earlier observations by Casey, Aycock, Kessel and Gordon on the infectious and incubation periods are confirmed, and the original high percentage of patient to patient contacts noted in a rural epidemic is substantiated by finding the same conditions in a large urban area like Chicago in a nonepidemic year. 8. Present methods and criteria for the diagnosis of the disease must be revised.

ALPERS, Philadelphia.

TREATMENT OF PREPARALYTIC POLIOMYELITIS WITH GAMMA GLOBULIN. A. M. BAHLKE and J. E. PERKINS, J. A. M. A. **129**:1146 (Dec. 22) 1945.

Bahlke and Perkins believe it can be conclusively stated that, in a series of 111 patients with preparalytic poliomyelitis observed for approximately six months after onset, no benefit was detectable when 56 of them who had received large doses of gamma globulin intramuscularly in the preparalytic stage were compared with 55 alternate, untreated, controls.

ALPERS, Philadelphia.

A STUDY OF THE ORIGIN OF AN EPIDEMIC OF POLIOMYELITIS. M. L. SMITH, E. M. BRIDGE, H. E. UNDERWOOD and G. E. DALE, J. A. M. A. **129**:1150 (Dec. 22) 1945.

Smith and her co-workers made a study of the origin of an epidemic of poliomyelitis. The work covered the circumstances surrounding the development of the first 3 paralytic cases of poliomyelitis in the 1944 epidemic in the Buffalo area. The evidence indicates that these cases did not arise *de novo,* but were relatively late developments in a cycle which had been in progress, but unsuspected, for approximately three months. Although a period of five and one-half months elapsed between the last reported case of the preceding season and the first of the 1944 epidemic, the interval was only two months prior to the earliest minor illness in 1944 which, on the basis of circumstantial evidence, was caused by the virus of poliomyelitis. In view of the difficulties in recognizing such minor illnesses, it is probable that the virus was continually active in the area throughout the entire period between the two cycles. The incidence of illnesses in the community which were highly suggestive of being nonparalytic forms of the disease was at least five times that of recognized poliomyelitis. The week by week distribution of these suggestive illnesses followed the same general pattern as the reported cases, but began earlier in the season and extended later. Other minor illnesses, simulating ordinary gastrointestinal and respiratory infections, were also widely prevalent. Although no laboratory studies were made, the evidence presented suggested that the Buffalo epidemic was initiated and spread largely through direct human sources, and not from polluted sewage, streams, toilets or unsanitary environmental conditions. It is suggested that the definition of an epidemic of poliomyelitis be broadened to include the preparalytic and postparalytic phases of the cycle.

ALPERS, Philadelphia.

NEURILEMMOMA IN REGION OF THE RIGHT AXILLA IN A CASE OF RECKLINGHAUSEN'S DISEASE: EXTIRPATION; RECOVERY. OSCAR L. GÓMEZ and JOSÉ A. URQUIZO, Prensa méd. argent. **32**:497 (March) 1945.

Gómez and Urquizo report the case of a solitary neurofibroma in the right axilla arising from the musculocutaneous nerve in a man aged 21. The tumor had remained about the same size since the patient had noted it, one year prior to its extirpation. There was no pain in the right upper limb, but the patient complained of heaviness and ready fatigue of the limb. No tumors were present in any other part of the body. There were many pigmented spots over the face and body, of irregular size and distribution, with a *café au lait* tint. The tumor on extirpation appeared fusiform and measured 5.5 by 3.5 cm. It was well encapsulated, showed

no signs of malignancy and proved to be a neurofibroma histologically. The fibers of the musculocutaneous nerve were separated, without having been destroyed.

N. Savitsky, New York.

Tumor in the Neck and in the Retropharyngeal Space—Neurofibroma. A. R. Albanese, Prensa méd. argent. **32**:1763 (Sept. 7) 1945.

In 1940 a woman aged 48 noted an increase in the size of her neck. Dysphagia appeared later. In 1942 the tumor reached its maximum size. The tumor seemed to decrease in size temporarily when her periods reappeared, after amenorrhea for two years. Apparently, an operation was performed during the early part of 1944. Before the operation, extension of the head produced dyspnea. Examination of the throat showed that the posterior wall of the pharynx was pushed forward by the tumor. Roentgenograms showed a retropharyngeal mass, pushing the trachea and esophagus anteriorly. There was no Horner syndrome. The tumor, which was removed by a Kocher incision, measured 10 by 12 by 4 cm. The histologic diagnosis was neurofibroma, arising either from the cervical sympathetic or the pharyngeal plexus. The author notes that the absence of Horner's syndrome does not exclude the sympathetic origin of the tumor. In December 1944 the patient was reexamined. There was definite diminution in volume of the neck. A tumor measuring 3 by 4 cm. was seen in the posterior wall of the pharynx which was either an organized hematoma or part of the tumor which had not been removed.

N. Savitsky, New York.

Peripheral and Cranial Nerves

Ingravescent Neuronitis with Recovery. J. M. Nielsen, Bull. Los Angeles Neurol. Soc. **10**:77 (March-June) 1945.

Nielsen reports the case of an unmarried white man aged 27 with "slowly developing paralysis." In 1933 the patient first noted "numbness" in the right hand, which felt as though it were asleep. In 1934 the right arm continued to feel numb and became weak, and the patient dragged the right foot. At first he attributed his symptoms to the fact that in 1932 he had sustained a fracture of the right humerus. Motor weakness of the right foot had been present for several months, and then the entire lower limb became numb. The following year the left foot became involved in a fashion similar to that of the right, and the left arm followed in this pattern, except that weakness preceded the numbness. Soon afterward the right side of the tongue became numb and the voice became weak. The weight had dropped from 160 to 100 pounds (72.6 to 45.4 Kg.).

In 1937 the patient was "stiff as a board." He had retention of urine and feces, requiring catheterization and use of enemas. Repeated tests for syphilis gave negative results. He had constant left-sided headaches.

In 1939 gradual improvement set in. In 1943 he was examined by the author. He came in a wheel chair and was able to walk with crutches. Physical examination at that time showed that the patient was well nourished and had regained all his lost weight. There was no muscular atrophy, but his shoulders drooped. Neurologic examination showed spastic paresis. The only other significant finding was old exudate in the fundi, the amount being greater in the right than in the left. The pupils were unequal, measuring 4 mm. in the right eye and 5 mm. in the left eye. The left pupil responded poorly to light and with a hippus. All deep tendon reflexes were distinctly increased. Babinski, Chaddock and Oppenheim reflexes were present bilaterally. Examination for sensory modalities gave normal results, but sphincteric control was impaired.

The patient was observed again in 1944 and was able to walk with two canes. Steady improvement was in evidence.

Nielsen comments that it taxes the imagination to visualize the pathoanatomic process and the type of infection which could thus spread throughout the spinal cord and peripheral nerves over a period of five years and still recede to a great

degree in the course of the next six years. He states that infectious neuronitis must serve as the best diagnosis but that the case, even as such, is unique. The case demonstrates the inadvisability of giving an unequivocally poor prognosis even in an apparently hopeless situation.

GUTTMAN, Philadelphia.

DISTURBANCES IN OCULAR MOTILITY ASSOCIATED WITH HYPERTHYROIDISM. EUGENIO FILIPPI-GABARDI, Riv. oto-neuro-oftal. **17**:564 (Nov.-Dec.) 1940.

Filippi-Gabardi reports a case in which a cogwheel phenomenon of the eyes was noted during the course of hyperthyroidism. A woman aged 31 complained of tremors in the upper limbs and of diplopia. She had sensations of constriction in the throat, dyspnea with exertion, headaches, sweating, occasional vomiting, epigastric distress and recent loss of weight, in spite of adequate intake of food. Examination showed tremors in both the upper and lower limbs, being more pronounced in the upper; mild enlargement of the thyroid gland; a basal metabolic rate of 46 per cent; a blood pressure of 125 systolic and 65 diastolic, and a pulse rate of 92. The oculocardiac reflex was negative; the Graefe, Dalrymple, Stellwag and Gifford signs were absent; the pupils were equal and regular and reacted well to light and in accommodation. At rest both eyeballs showed some inward deviation; when either eye was covered the inward deviation of the covered eye increased; there was normal convergence, but a tendency to immediate return to the position at rest. During lateral movements, while the eyes were following an object, cogwheel movements were noted; these became less noticeable with extreme lateral movement. The cogwheel movements were noted on upward or downward gaze. Examination with the red glass test showed homonymous diplopia, which increased in intensity as the light object approached the point of fixation. The fields were normal; prisms did not correct the diplopia. After treatment for twenty days, diplopia was noted only in the right lateral field, and the mild inward deviation of both eyes disappeared. Improvement was noted in the general condition. After one and a half months the diplopia disappeared entirely, reappearing later on left lateral gaze. The author ascribes the ocular disturbances to impairment of tone of the ocular muscles resulting from a vegetative imbalance which accompanied the hyperthyroidism.

N. SAVITSKY, New York.

Society Transactions

NEW YORK NEUROLOGICAL SOCIETY AND NEW YORK ACADEMY OF MEDICINE, SECTION OF NEUROLOGY AND PSYCHIATRY

Joseph H. Globus, M. D., President, New York Neurological Society, in the Chair

Combined Meeting, April 9, 1946

Bilateral and Multiple Ruptured Disk as a Cause of Persistent Symptoms Following Operation for Herniated Disk. Dr. Francis A. Echlin and Captain Bertram Selverstone and Major Walter E. Scribner, Medical Corps, Army of the United States.

It has been established that the acute symptoms due to herniated lumbar disk can be relieved by removal of the offending disk in most cases. Permanent relief of acute symptoms has occurred in a large proportion of patients who have been able to avoid undue physical strain after operation.

On the other hand, most surgeons will agree that recurrence or, less often, persistence of moderate to severe symptoms following operation for a herniated lumbar disk is by no means uncommon, especially when the patient has undertaken heavy work. The cause of these symptoms is usually obscure. In the great majority of instances they have occurred in patients who had a solitary herniation which apparently had been adequately removed. Multiple herniations cannot therefore account for the symptoms in these cases. In the present paper, further observations are presented, however, which support the belief that these recurrent or persistent symptoms may at times be due to the presence of bilateral or multiple ruptured disk which may be overlooked at the first operation.

In this presentation, time does not permit a detailed analysis of our observations. Briefly, in a series of 60 cases in which operation was performed about a year ago there were 10 proved instances of multiple herniated disk. In other words, in 16.6 per cent of this series of 60 cases multiple herniated disks (two or more) were encountered in the lumbar region. In addition, in 4 cases bilateral herniation required bilateral exploration for removal.

Experience in the Army has proved that the problem of herniated disk is not a simple one. Recurrence or, less often, persistence of moderate to severe symptoms, both organic and functional, following operation has been only too frequent, especially when the patient has been required to do heavy work. In Army life, a functional element has probably played a greater role in precipitating these symptoms than in civilian life, but in many cases the causative factors are not clear, or at least there is a wide difference of opinion concerning them. In the great majority of cases in which such symptoms were presented a solitary herniated disk had apparently been adequately removed. As pointed out, multiple herniation cannot, therefore, account for the symptoms in this group. It is believed, however, that the series of cases reported illustrate that bilateral or multiple herniation which may be overlooked at the first operation may at times account for this persistence or recurrence of symptoms.

Clinical signs alone usually fail to indicate the presence of more than one herniated disk, and therefore cannot safely be relied on to disclose the multiple lesions under discussion. Myelographic studies with Pantopaque (an iodized poppyseed oil) are helpful in revealing the presence and level of such lesions and, in our opinion, are indicated in all cases. This procedure, however, occasionally may also fail to reveal a ruptured disk, especially when the herniation lies far laterally. In the presence of a negative myelogram, decision to operate will depend on the severity of the symptoms and on whether or not the clinical picture is

characteristic of a herniated disk. Likewise, decision to explore multiple defects will depend on their nature, the patient's symptoms and the surgeon's clinical judgment.

It should be emphasized that, although the removal of multiple ruptured disks will usually relieve acute symptoms, heavy work is probably more likely to precipitate postoperative symptoms in patients with such lesions than in patients who have required the removal of only a single disk. The fact that multiple herniations are relatively common therefore only emphasizes the complexity of the problem.

DISCUSSION

DR. JOSEPH E. J. KING: We are indebted to Dr. Echlin and his associates for their informative presentation. Originally, Dr. Mixter and Dr. Barr, who probably deserve more credit than any one else in this country for establishing herniation of an intervertebral disk as an entity, told us how the definite diagnosis could be made in most cases. They used a radiopaque substance, iodized poppyseed oil 40 per cent. Their precepts were followed for a number of years, by and large, over the country.

It is believed that recently a radiopaque substance, either iodized poppyseed oil 40 per cent or Pantopaque, has not been so widely used as formerly. It is my impression that surgeons and neurologists have relied more on physical and neurologic examinations in making the diagnosis. Moreover, some authors have gone so far as to say that lesions of the intervertebral disk are the most common cause of pain in the lower part of the back, with or without sciatica (Key, J. A. (St. Louis): *Tr. South. S. A.* **55**:150, 1944).

Operations have been carried out without a definite diagnosis of even one herniated intervertebral disk, not to speak of multiple lesions. In fact, I believe most neurosurgeons have operated at some time without the use of iodized poppyseed oil, Pantopaque or air. In some sections it has become almost a fad to recommend operation for herniated disk on the slightest provocation, and at times no such lesion is to be found, unless it is "invented." Some disks have even been designated as "concealed."

I have had no experience with multiple herniated disk. I have operated on patients, with and without the use of a radiopaque substance, and have failed to find a herniated disk. I feel sure that I have missed some. Although most of the patients have been relieved of their pain, others have continued to complain of pain in the back, and some even of pain down the other leg.

This brings me to the point of the authors' presentation. They have shown that multiple lesions exist, and in cases in which the bilaterality was not even to be suspected from the signs and symptoms. Not only that, they have removed these disks in the series of cases cited. These facts explain why some patients in the past have not been relieved of their complaints. The high percentage of cases of multiple lesions in Dr. Echlin's series warrants a more thorough preoperative effort at complete diagnosis than has been made in the past. I am convinced by his experience that roentgenograms with the radiopaque solution in situ should be made routinely when a likelihood of herniation of an intervertebral disk exists. By so doing, the operative results will improve. Although such studies entail more work and consume more time, and although it is tedious to remove the solution, the examination should be carried out. It has been demonstrated that Pantopaque can be removed almost entirely, and the very small amount that may remain is of no concern.

Only today I read an article by Dr. James White, of Boston, and Comdr. T. H. Peterson (MC), U.S.N.R. (Lumbar Herniations of the Intervertebral Disk, *Occup. Med.* **1**:145 [Feb.] 1946), in which ten papers were listed, all by recognized authors. An enormous number of cases are represented, about 900, from their various services. White and Peterson classify the results as excellent to good, fair and unsatisfactory. I was surprised that these physicians had good results in about 67 per cent of their patients, 17 per cent of their patients showed improvement,

and in about 13 per cent treatment gave unsatisfactory results or made the condition worse. I think, therefore, that Dr. Echlin's paper is timely.

DR. BYRON STOOKEY: Dr. Echlin let me read his paper, and I am amazed at the number of cases of multiple ruptured disk which he has seen. The frequency with which he has found these lesions is far beyond anything that I have encountered. It may well be that I have missed them; however, the high incidence of multiple herniated disk in the military service may have to do with the special forms of duty. Driving and riding in jeeps or tanks, dive bombing and many other duties associated with combat may be determining factors in the production of multiple herniation of the nucleus pulposus.

For a long time my associates and I refused to use iodized poppyseed oil and resorted to it only occasionally. We have tried oxygen myelography, but I must say that, though this is a procedure which I originally recommended, it is not satisfactory, frequently because the interspace between the fifth lumbar and the first sacral vertebra is not shown and therefore one of the most common locations is not visualized. However, even with Pantopaque, herniations of the nucleus pulposus have not produced any defect in the oil column, and yet at operation the lesions have been encountered.

With an interlaminar approach, neither the strength nor the mechanics of the spine is materially disturbed; hence, when the clinical signs are sufficiently definite an exploration should be made. A negative result in a Pantopaque study does not preclude the existence of a true herniation, and this is especially true with respect to the interspace between the fifth lumbar and the first sacral vertebra. Thus, the diagnosis of herniation of the nucleus pulposus cannot always be made with certainty. The neurologic signs are often equivocal and the Pantopaque studies not necessarily conclusive. The same may be said of myelograms taken with iodized poppyseed oil 40 per cent or oxygen and of oxygen epidurograms.

Dr. Echlin has called attention to the important point that herniation may be multiple, and in his military experience it has been multiple in a relatively large percentage of cases. He has demonstrated without question that a bilateral herniation may exist with signs only on one side and that removal of the herniation from one side, though thorough, does not reduce the herniation on the opposite side. His clinical materials indicate that Pantopaque studies are essential for the diagnosis of multiple herniations. I came to that conclusion reluctantly, because I prefer to make my diagnosis on the basis of the neurologic findings; however, I am sure that I could not establish the diagnosis of multiple herniation on the neurologic signs alone; either Pantopaque studies must be made, or the surgeon must operate without using Pantopaque and explore from two to three lumbar spaces; and as between these two alernations, I prefer the Pantopaque study.

I agree with Dr. King that operation for this lesion has not been so successful as one would wish. A number of patients have continued to complain after removal of the herniation. On the other hand, there are patients in whom no herniation was seen who have been completely relieved of pain. For these reasons, I come to the operation with considerable misgiving. From a purely technical standpoint, the interlaminar approach is simple, disturbing so little of the mechanics of the spine that an exploration can be done with a minimum of injury. With this approach, the patient does not require a fusion unless obvious mechanical disturbances of the spine are demonstrable, and in such a case fusion is not precluded by the simple procedure in an interlaminar approach.

Dr. Echlin is to be congratulated on his thorough study and on his calling our attention to the frequency of multiple herniation and to the fact that the herniation may be bilateral and yet give no signs on one side.

Electroshock and Personality Structure. DR. ERICH P. MOSSE (by invitation).

The effects of electroshock therapy are psychosomatic phenomena. The spectacular changes of behavior are due not only to an alteration in the electrophysio-

chemical metabolism of the brain cells but to the psychologic experience of the shock as well. The individual difference in the types of convulsions is not due alone to weather conditions, application of the electrodes to different spots, differences in thickness of the skull or differences in the current. It is also the patient's willingness, and often observed masochistic eagerness, and his craving for atonement to ease his guilt that keeps the threshold lower in some cases than in others in which aggression, anxiety or stubbornness is a deep-rooted trend of the neurosis.

The psychologic reactions during the ten to thirty minutes following the pulling down of the electric switch have one common denominator: All of them show more or less dramatic signs of regression on the oral or infantile aggressive level, or other infantile sexual manifestations. The success of the treatment is essentially due to a battering down of the defense mechanisms, which is a reaction of the ego to the conflict between the id and the superego. This superego is destroyed or eased by the experience of the shock as an utter punishment by the parent-psychiatrist, in whose basic kindness the patient can confide. Another factor is the temporary impairment of memory. One must conceive of the structure of the whole personality as a kind of tree, which from earliest childhood has kept intact each minute of emotional experience in its time layers. The postshock defects of memory would then mean that the electric current affects that part of the mental apparatus which deals with the selective process of repression. On the one hand, experiences are forgotten; on the other, the forgotten is recalled. This paradox can be understood only if one assumes the existence of a special memory organization, which is affected and stimulated as a whole by the electric shock. In this process of "transmutation" one is not able to discover any specifically selective trends other than those provoked by the easing process of the superego.

The most impressive psychologic effect of the shock is the strengthening of the ego—its detachment from the aforementioned pathologic regressions and, with that, its increased endeavor to give them up. It is significant, in this connection, that a considerable increase of potency can be found in the great majority of patients after the shock. This might be due partly to direct stimulation of neuronic metabolism; however, that does not exclude the fact that the decrease in guilt feelings produced by the atonement through punishment liberates the object cathexis of the blocked and repressed libido. Thus it is understandable why the psychoses show a much better and more spectacular improvement than the psychoneuroses; the accumulated guilt is much more deeply experienced in them than in the neuroses.

DISCUSSION

DR. FOSTER KENNEDY: I was unable to gather everything that Dr. Mosse was saying, but practically everything I heard him say I disagree with. He has made an effort to combine, willy-nilly, something in the psychologic mechanism which has been familiar for the last thirty years, as described by Freud, with an entirely new instrument of treatment and has tried to belittle the latter in terms of the former. Perhaps I have had as much experience as any one with electric "shock" treatment, having begun its use in 1940 and having used it almost daily since that time; so I cannot agree at all with many of Dr. Mosse's statments. For instance, he said that results of electric shock treatment come from "the death threat." That has frequently been said. Perhaps my patients are not as afraid of dying or as anxious to die as are others; but I am quite sure that the "death threat" plays no part in their progress and frequent recovery. One of my patients was a lawyer, a full time associate professor of law. I have seen him through three very severe agitated depressions, two of them in the years before the advent of electric shock treatment. Each of those attacks lasted about five years and confinement in a mental hospital was necessary. In the last attack he severed his trachea, after taking enormous quantities of alcohol, and threw himself into the sea. He was rescued and, with good surgical treatment, was saved, after the expected long illness. During the six months required to recover from his surgical condition, he was as agitated, as ill with somatic sensations and apprehensions of despair as

he had been before he became unconscious through his desperate suicidal attempt. I do not think any one could have had a greater "death threat" than be administered to himself. On his recovery from the operation and illness, I persuaded him to submit to electric shock treatment, which he did, and in three weeks he was entirely free from symptoms. The "death threat" of the electric current evidently did something that the "death threat" of the sea and his severed trachea had not done!

Dr. Mosse said, dogmatically (I am quite sure that I am quoting him correctly) that "no electric shock treatment can cure a mental disease without psychotherapy." Before one can discuss anything, one must define one's terms. A woman aged 78 who had been in Bloomingdale Hospital for about a year with a severe depression, constant agitation, utter despair, constant moaning and sleeplessness can, I suppose, be called psychotic. This woman was cured in two treatments without psychotherapy and has remained free from symptoms and in possession of her normal happy, optimistic personality, for the past three years.

DR. JOHN A. P. MILLET: The last discussion indicates a lack of openness of mind which is regrettable in scientific matters. Much of Dr. Mosse's paper is provocative. One may not agree with all his conclusions. The approach of psychology to shock treatment is still in its infancy, but its application will certainly reveal a great deal about this method, particularly from the standpoint of how to treat the patient both before and after shock. One hears many reports of the threats from shock treatment to the patient's final mental integrity. The lay press has picked up some of these reports; in a recent issue of *Science News Letter* there is such a story. It is incumbent on all scientists who are interested in trying out this important new therapy to be careful what they state in their published articles. The outstanding feature of the treatment—a point on which I can agree with Dr. Kennedy—is that it can cure certain patients without psychotherapy. This does not mean, however, that it cannot be used as an adjuvant to, and as a support for, effective psychotherapy. These are two entirely separate features of the value of treatment. I wonder how many who have used the treatment have been scared off from completing it by the appearance of a new type of psychosis during the treatment period, after five or six applications of the electric current. Certain repressed contents in the personality of the patient are unleashed by the application of electric shock. These secondary psychoses, which Dr. Kalinowsky has so ably presented, are one of the best proofs of this release; as he has also shown, if the treatment is continued, the secondary psychosis will clear up automatically.

The approach to the apparatus in electric shock is, in my opinion, almost as important as the application of the current itself. The nonsense of wheeling in a lot of apparatus and of placing heavy pressure on various parts of the body in order to prevent the patient from some damaging effect of the convulsion is outmoded. Any one who has seen Dr. Kalinowsky demonstrate this treatment, and the ease with which he does it, and has observed the absence of necessity for any forcible holding of the body will become convinced of the danger of such a procedure. I wish to congratulate Dr. Mosse for bringing the psychologic aspects of electroshock treatment to the attention of this audience.

SYMPOSIUM ON THERAPY OF THE PSYCHONEUROSES

Elements in Psychotherapy. DR. CLARENCE P. OBERNDORF.

My thesis is that the element of suggestion, in the sense that suggestion is a transference phenomenon, is essential in all forms of psychotherapy. Constant elements in all psychotherapy are (1) the person or agency instituting the treatment, (2) what is said or done, (3) when it is said or done, (4) how the treatment is administered, and (5) the susceptibility of the person to psychotherapy.

Psychoanalytic investigation has contributed a vast amount of information concerning the mode of operation of all these factors, but in psychoanalysis itself suggestion plays an important role, particularly as related to the person who undertakes the treatment and the way in which he administers it.

Brief reference was made to 2 cases of a condition considered to be a psychoneurosis. In the first case shock therapy had greatly improved the patient's condition after psychoanalytic treatment had failed. In the second case, after long, unsuccessful general psychiatric treatment and shock therapy, psychoanalysis proved strikingly effective.

Results of Hospital Treatment, Including Electric Shock, of Psychoneurotic Patients. Dr. James H. Wall (by invitation), and Dr. Donald M. Hamilton, White Plains, N. Y. (by invitation).

During the past twenty-five years there has been a gradual increase in the number of patients with psychoneurotic disorders admitted to the New York Hospital—Westchester Division. In 1921 there were 21; in 1931, 30, and in 1945, 68. In 1941 and 1942 we made a study of the hospital treatment of patients with psychoneurotic reactions (*Am. J. Psychiat.* **98**:551 [Jan.] 1942; **99**:243 [Sept.] 1942). It was a review of our experience with 100 men and 100 women patients admitted consecutively over a ten year period. These patients were carefully studied physically, and any physical disorder, which was rare, was treated promptly. The patients were placed on a regular dietary regimen and were encouraged to engage in a full program of occupational therapy, physical education and social activities. The physician directed these activities and conducted the psychotherapeutic interviews. During their hospitalization many patients realized for the first time in their lives the value of regular habits of living.

During the past four years electric shock treatment has been added to this therapeutic program for patients with psychoneurotic disorders. Patients to be given electric shock are selected from those who do not show a quick response to the usual therapeutic regimen of the hospital. We have found that electric shock treatment was indicated for only one third of the patients with psychoneurotic disorders who were admitted to the hospital. The giving of electric shock is carefully timed and is associated with intensive psychotherapy.

From 1942 to 1944, inclusive, a period of three years, 50 patients with psychoneurotic disorders were given electric shock therapy. The results in this group were compared with those obtained in the earlier series of 200 psychoneurotic patients whose treatment was not supplemented with electric shock.

The most striking difference between the two groups is in the average length of hospitalization. In the non-shock-treated group this was eight and three-quarters months, whereas with the shock-treated group it was five and one-half months. Thus the period of hospitalization of the patients who received electric shock therapy was less than two-thirds that of the patients who did not receive this treatment.

The difference in the percentages of recovery of the two groups was not great —39 per cent of the 200 non-shock-treated patients and 46 per cent of the 50 shock-treated patients. This is not an impressive difference, considering the great difference in the size of the two groups. However, 80 per cent of the shock-treated patients had returned home, recovered or with their condition much improved, whereas only 59 per cent of the non-shock-treated patients were so benefited; the status of 151 of the 200 patients who did not have shock treatment was considered to have improved to some degree, whereas that of 48 of 50 of the shock-treated patients was considered to have improved.

Results of Treatment of Psychoneuroses by the General Practitioner: A Follow-Up Study of 500 Patients. Dr. Peter G. Denker.

Five hundred patients with severe psychoneuroses, all of whom had been ill for three to six months before disability benefits were granted, were studied in sequence. All these patients were treated by general practitioners throughout the country, and were not patients of psychiatrists, psychiatric institutions or psychoanalysts. The therapy instituted was of the usual type resorted to by the general

practitioner, with reassurance, suggestion, discussion of conflicts and sedation. With none of the patients was "deep psychotherapy" used. These patients were kept under observation for at least five years, and many of them for as long as ten years, with the results indicated in the tabulation.

Time Required for Apparent Cure After Onset, Yr.	Number	Percentage of Total Series
1	233	44.6
1-2	135	27.0
2-3	48	9.6
3-4	26	5.2
4-5	18	3.6
Still disabled after 5 yr	50	10.0

It can be readily seen, therefore, that in this series of patients with severe psychoneuroses, whose inducement to get well was certainly not helped by the fact that disability benefits were received monthly for the duration of the illness, approximately 45 per cent "recovered" within one year, complained of no further, or only very slight, difficulties and made successful social and economic adjustments. Another 27 per cent took from one to two years for a similarly successful outcome, making a total percentage of "recoveries" of 72 within two years.

These results were compared with various reports in the literature from psychiatrists, psychiatric sanatoriums and psychoanalytic institutes. It was found that approximately the same percentage of cures was reported regardless of the type of psychiatric therapy used; all figures show between 60 and 80 per cent of patients "apparently recovered" or "much improved" within a two year period.

It was concluded that the type of therapy instituted was of secondary importance, provided the patient was treated with sympathetic common sense and great patience on the part of the physician, confidence in the physician being an important factor. The physician should appreciate the importance of the "time factor" in the gradual readjustment of these patients, must allow them adequate opportunity to pour out their apparently never-ending series of complaints and use common sense and honest reassurance in discussing their conflicts with them. He will then be surprised at the remarkable degree of success he can attain without resorting to specialized help, except in the minority of cases.

DISCUSSION ON SYMPOSIUM ON THERAPY OF THE PSYCHONEUROSES

DR. GEORGE BAEHR: After listening to Dr. Denker's paper, I understand why I have been invited to open the discussion—to express my condolence with the psychiatrists, who are no longer needed in care of the psychoneuroses. There is a grain of truth in Dr. Denker's paper. The general practitioner has an important contribution to make, if he knows how. It would have been wrong to have had this discussion end without something being said about the contribution of the general practitioner to psychotherapy and the prevention of disease. Although I cannot agree with Dr. Denker that psychotherapy can be left to the practitioners of medicine, I must admit that the general practitioner is in a position to play a more important role than the psychiatrist in preventive medicine in the field of the psychoneuroses. The psychiatrist's relation to the treatment of the psychoneuroses is like that of the surgeon to surgery; the general practitioner can, and does, handle most of the minor psychoneuroses, although often not very well; he occasionally can handle a major psychoneurosis if he is particularly qualified and if he has a deep interest in his patient and the gifts of human understanding and sympathy A general practitioner of experience can acquire the proper approach to his patient, so necessary to secure that transference which Dr. Oberndorf emphasized. The chief function of the general practitioner, to my mind, is prevention; he can prevent the development of a great many of the preventable anxieties by his approach to patients with organic disease, and he is in a position

to relieve the anxieties of those who come to him for psychosomatic disorders. One hears a great deal from psychiatrists about the prevention of the psychoneuroses. The overwhelming importance of these disorders is revealed not by mortality, but by the morbidity, statistics, which, if correctly interpreted, indicate that the psychoneuroses play a greater role in human unhappiness and human illness than does cardiac disease, cancer or tuberculosis. As yet, no appreciable progress in prevention has been made, and not much progress will be made until the psychiatrists learn to work in closer relation with the interns and residents in the wards of hospitals and with general practitioners and medical specialists in private practice.

Nation-wide discussions in recent years concerning psychosomatic disorders have brought psychiatry closer to medicine, and medicine closer to psychiatry. The psychiatrist who concerns himself solely with institutional psychiatry or whose days are filled with the private practice of psychoanalysis may be playing an important role in everyday life, but not one of great social significance. A real contribution to social and medical progress can be achieved by psychiatrists who work in close relation to internal medicine, as an integral part of the department of internal medicine of a general hospital. Personal psychiatry must be as integral a division of a department of internal medicine as is the division of cardiac disease or any of the other disciplines of medicine. As internists, we welcome, in fact we plead for, that close relationship. We need it, because as internists we see by far most of the psychoneurotic patients, of whom psychiatrists see only a small fraction. The great majority of the psychoneuroses, which constitute most of the disabilities of everyday life, are our responsibility. We handle them perhaps poorly; we are often responsible for creating them; we need the help and the cooperation of psychiatrists if we, as internists, are to be more effective in preventing disease.

DR. A. A. BRILL: I was very much interested in all the presentations and was particularly pleased to hear what Dr. Baehr has just said, "There is a grain of truth in what Dr. Denker said." Yes, just a grain! When Dr. Denker compares his series of psychoneurotic patients with those who were treated by psychoanalysts, he forgets that the latter belong to quite a different class. They do not come to the analyst after three months of illness. They usually come after years of nonanalytic treatment. They represent that percentage of neurotic patients in Dr. Denker's category who do not improve with other treatment. We psychiatrists do not see the neurotic patients who get well in one year, or in two or three years. The neurotic patients who eventually come to me for treatment have already received every sort of therapy for years.

I am also much impressed with what Dr. Baehr said about the responsibility of the internists for the large number of psychoneurotic patients. We have known this for a long time, and I am pleased to hear it corroborated by him. I agree with him that an understanding on the part of the internist and the surgeon of the psychic mechanisms underlying the psychoneurosis not only would obviate much unhappiness but would decrease the number of chronic neuroses, which we psychiatrists find so difficult to cure, and which present such a problem to the state.

I was much impressed with Dr. Mosse's paper. I am in an anomalous situation with respect to shock therapy. I became interested in it when it was applied solely to the treatment of schizophrenia. I saw it first in Europe, particularly in Switzerland, where only Sakel's method was used. I can say that I introduced it into New York city, for on Dr. Sakel's first day here I urged him to instruct the state hospital physicians in his therapeutic methods. I had him meet the state commissioner of mental hygiene and about a dozen of the leading psychiatrists of the state, and he consented to instruct the state hospital physicians. I have, of course, been interested in the results both here and abroad. Having seen a number of panaceas in psychiatry come and go since the turn of this century, I adopted the attitude of watchful waiting. As time went on, I was more and more disappointed in the results obtained in treatment of schizophrenia. The first report

on shock therapy of this disease was made by a commission of leading Swiss psychiatrists, who confined themselves to the treatment of schizophrenia with Sakel's and Meduna's shock methods. They expressed the opinion that shock therapy may "in favorable cases" shorten the attack, an effect which is also possible with other means, but that it has no other effect on the disease. Recently, I read a paper by Dr. Manfred Bleuler, who came to virtually the same conclusion. In his paper (*Das Wesen der Schizophrenieremission nach Shockbehandlung*), based on cases occurring in the Basel Psychiatric Clinic from 1936 to 1941, in which the treatment was successful, he states that the results in the treated patients were the same as those in the patients who were not treated with this method, that biologically cure with shock therapy resembles spontaneous recovery and that the schizophrenic process is not influenced by the treatment. The patients he studied were observed from three to four and a half years after they had been successfully treated with shock.

I assume that Dr. Kennedy's patient was not schizophrenic but had a depression. It is recognized, of course, that patients recover from depressions with or without the help of a psychiatrist. I cannot agree, therefore, with Dr. Kennedy that shock therapy cured his patient. This patient had had two previous attacks, from which he recovered without any shock therapy. In his last attack, he attempted suicide but recovered in eight months, after a few shock treatments. How does one know that the shock therapy had anything to do with his improvement? As a matter of fact, experienced psychiatrists know that after a suicidal attempt the patient invariably recovers from the attack sooner than from attacks without such an act. Dr. Oberndorf might have discussed the meaning of the suicidal attempt. It is in itself a shock which the patient administers to himself. Having thus paid his debt to the superego, the patient recovers without the need of further shock. I do not think that one has the right at present to draw conclusions about the efficacy of shock therapy of depressions from which the patient not only recovers spontaneously but can be "cured" by other, less risky, methods. Every week I see patients with depressions who have not benefited from shock therapy; on the contrary, they claim that the treatment has made them worse. I know of patients who formerly went through depressions and recovered completely in a few months whose attacks were aggravated by shock therapy. Some complain of poor memory and other disagreeable symptoms, which I have no doubt are produced by shock therapy. I feel that psychiatry is at the very beginning of a new experiment which may or may not be recognized later as a therapy of some merit, but until the technic is improved and unified one has no right to talk of "cures." It must be remembered that even schizophrenia, especially the schizoid-manic type, shows spontaneous remissions. Patients with manic-depressive psychosis invariably had remissions, or, perhaps better, recoveries, from the attacks long before shock therapy was heard of.

Psychiatry is on the brink of a new era, perhaps an era of great discoveries, which may come from physical therapy or from psychotherapy, probably from both. In listening to the speakers, however, I was impressed with their all using terms and schemes outlined by Freud. Dr. Mosse attempted to interpret the behavior of the patients during shock therapy in terms of the psychic apparatus. Others may give a different interpretation; this is really immaterial; there is room for various interpretations. Personally, I feel that the only consistent and logical interpretation of neurotic manifestations is the one given by Freud. I was pleased to hear that Dr. Wall and Dr. Hamilton followed essentially this principle. It was gratifying to hear that all the speakers stressed the value of psychotherapy following shock therapy.

DR. FOSTER KENNEDY: It would seem necessary for us to unify our thinking. No one here has made the least attempt to define a neurosis. There are probably as many opinions as to what a neurosis is as there are persons in this room. Neurotic persons act, feel and think unsurely. Some people are unsure in acting, feeling

and thinking from time to time and are valid, well integrated, realistic and well controlled in the intervals between. Why do they become subject to a compulsive neurosis overnight, as many do, and I have seen many do, and remain the victim of a compulsion: to wash continually, to pick up paper, to read numbers, to ascertain in a paranoid way whether their domestic happiness is endangered? Why do some under the whip of these obsessions and ritualistic superstitions in a matter of six months or a year or, as Dr. Denker's figures show, in about two years find the neurosis disappearing? The patient then becomes himself again, whatever may be the treatment—supportive, suggestive or analytic. Most of these patients, whatever treatment is administered, become well in time, and whoever is treating them when they recover gets the credit. I have never deceived myself about this in the past, though I have often had the credit for the cure in such a situation. In the last five or six years I have treated many such patients with electric shock. Many have been old patients; some came to me first twenty-five or thirty years ago. Their own records may be taken as a control. Many were ill with the same symptoms for intermittent periods lasting over six months; some had neurotic periods of three to five years, and in the intervals between they had long periods of normal and courageous living. Dr. Brill asks how I know that my patient, the professor of law, would not have recovered without any shock treatment. My answer is that this patient, who has been under my care twenty-five years, has a history of two previous illnesses during that time, with a definite cycle; one lasted four and a half years and the other five years. I have every reason to believe that he would not have recovered in less than four years without the shock treatment, which cured him within four weeks. Dr. Kalinowsky gave the treatments. Without electric shock treatment I have every reason to believe that the patient would not have recovered. When the treatments were started, he was exactly as ill as when he attempted suicide eight months before.

Of course, psychotherapy must be combined with physical therapy. That is true of all medicine and of all living. It is true of education; it is true of soldiering; it is true of the management of the patient; it is true in every relation between man and man. But "managing" a patient with an agitated melancholia will not "cure" him of the melancholia. In my belief, such a condition is part of the pulse of life to which we human beings are all subject; it is essentially a manic-depressive situation. Pathology having been endowed with a microscope, one has come to think of pathology only in terms of cells and fibers and to neglect the pathology of forces. The great tides of nervous energy kept in balance between pressor and depressor groups are what we live by. We are integrated in unstable equilibrium, like everything else in the universe. We live on a pulse—systole lives by diastole; we are all subject to variations, ebbs and rises of energy—but in the "normal" person these variations do not rise to consciousness. We are not aware consciously of our mild depressions or our mild elations; our better working form, our poorer working form. But a great mass of the population, the neurotic persons, go into depressions, which are exaggerations of the normal man's "slumps," and also into states of high elation. Often in elations such persons do the best work of the world. Musicians and poets are particularly prone to them. This abnormality in the government of emotional rhythm, implemented through the hypothalamus, as all vegetative rhythms, are, causes a change in mood; out of the mood and out of the imbalance the sick man dips down into the strata of consciousness in which he picks up his early life fears and superstitions. We are all superstitious below the surface, and when sufficiently troubled we nip back to our superstitious heritage. Every child is normally a superstitious poet with obsessions. He passes through this period of obsessive thinking, and when he is adult and in a depression he descends to the phylogenetic youth of thinking and feeling—partly to integrate himself against "mental" illness.

The idea of the mind being apart from the body is nonsense. Body and mind must be unified. One must not neglect physiology; one must not neglect psychology. Our words about thinking are a product of our divided allegiance; we readily

locate in "mind" whatever we would like to place elsewhere but, unfortunately, find no room for. The problem has a complexity which has arisen out of our way of speaking—and speech is, after all, a very recent tool. What we say about our inner feelings, our inner lives, is often a poor mirror of what truly goes on. I believe, as I said earlier, that in what has been so poorly called "shock" therapy there is added a great new instrument for the benefit of many obsessive states, depressive states, "mental" illnesses; "shock" therapy has given psychiatry a reliable instrument for the understanding, as well as the treatment, of "neuroses," and to its use there will always be added "psychotherapy," or the management and control of man by man.

DR. LAWRENCE KUBIE: To me this has been a distressing, discouraging and unilluminating discussion—chiefly claims and counterclaims; old catchwords and slogans. In every field of medicine one can hear this sterile debate about how much of the specialist's field the general practitioner can cover adequately. How can such a discussion be freed from bias? Obviously, only by examining precisely what part of the field the general practitioner sees and what part the specialist sees. To compare the "results" secured by the general practitioner with an undifferentiated group of patients with the "results" achieved by the specialist with that fraction which filters through to him is about as meaningful as it would be to compare the "results" obtained by the general practitioner in treating the common cold with the "results" of the specialist in treating tuberculosis, severe pneumonias, chronic bronchiectasis and the like. At the general practitioner's end is a large and heterogeneous array of benign, self-limited illnesses, with here and there a more serious process, which he may or may not recognize early, which fails to yield to his ministrations and which therefore goes to the specialist. At the specialist's end are the severe, chronic, and often neglected and undertreated, conditions which may reach him too late for help, and only after the patient has been knocked around far too long. This principle is so elementary and so universal in medicine that it is something of a shock to hear Dr. Denker use his statistics on compensation cases (notorious for the fact that they are in no way representative of the psychoneuroses as a whole, and for the fact that a large proportion of the patients recover as soon as the compensation issue is settled in one way or another) to prove that the general practitioner achieves the same results as the specialist. It is even more shocking and disturbing to hear this audience, presumably of critically minded and thoughtful persons, taken in and rocking with laughter at this "proof" that there is no need for more psychiatrists.

What type of psychoneuroses does the general practitioner actually see? First, he sees thousands of patients with neuroses which he fails to recognize because the true condition is masked by the common organic ailments which a neurotic patient can use to mask his neurosis (exactly as the hysterical patient can use hysterical symptoms). Most of these patients pass through his office without the general practitioner's even knowing that a neurosis has come his way. He also sees many acute transitory syndromes, such as the acute, transitory anxiety states which manifest themselves in cardiac, respiratory or gastrointestinal disturbances. He sees transitory neurotic depressions. He also sees, and rarely recognizes, the transitory emotional disturbances which mark the early phases of all the more severe psychoses. At the other end is the specialist in the psychiatric hospital, who sees the end results of this early neglect, that is, patients with severe, and sometimes permanent, psychoses who give a life story of early, transitory "neurotic" episodes, the importance of which was underestimated by the general practitioner, who treated them symptomatically. It is easy to fool oneself into thinking one has cured such a patient, but the curing of a symptom by the general practitioner all too often obscures a malignant process, which then goes on unchecked. I wonder whether Dr. Denker and Dr. Kennedy want psychiatry to return to the good old American game of sticking one's head in the sand. To me, it seems that in these last years of the war we psychiatrists have just pulled our heads out of the sand

and that it would be disastrous to bury them again. We cannot go back to treating these important, if transitory, neurotic episodes of childhood, adolescence and early adult life in this old bungling, ineffectual and disastrous fashion.

I hope we shall hear no more laughter about there being no need for more specially trained psychiatrists to deal with this problem.

By contrast, I want to refer to the beautiful presentation of factual data given by Dr. Wall and Dr. Hamilton. It is significant that no one has criticized this. The facts speak for themselves; and it is regrettable that this entire symposium has not been conducted on that level.

In such a symposium, we psychiatrists should begin with some honest self searching—asking ourselves what we know about the basic issue of the symposium. What do we know about the intrinsic and essential nature of the psychotherapeutic process? What do we know of the process of spontaneous recovery? What is the relation of spontaneous recovery to the recoveries that we seem to induce by our intervention, both in the neuroses and in the psychoses? What is the meaning of insight, and the relation of insight to spontaneous health and to the process of cure? What is the difference between the insight of schizophrenia and the insight of the recovery process? What is the difference between the insight which can be induced in a state of narcosis and the insight in the biochemical disturbances which occur after shock? How do the emotional discharge and the insight in such periods integrate with the emotional state and insight in the normal phase? These are a few of the questions which we should ask and discuss in such a symposium, instead of empty claims and counterclaims and vapid philosophizing.

Perhaps it is premature to ask for this, however, so long as all that we know about psychotherapy is learned in private practice. Historically we had to start in that way. Historically, however, we are now at the point at which this must end. The investigation of the psychotherapeutic process must become the concern of a research institute. Perhaps the major defect of this symposium is that it was held twenty-five years too soon.

DR. ISIDOR SILBERMANN: I was particularly impressed with Dr. Kubie's statement that discussions of this kind are not fruitful unless one knows exactly what one is talking about. I should be grateful to Dr. Wall and Dr. Hamilton if they would say a little more about the psychotherapeutic approach used at the Westchester Division of the New York Hospital. They have told how patients are given reassurance and have described various examinations and the use of music therapy, but they have said little about the kind of psychotherapy which is used and how it is carried out. It seems to me that at the modern hospital for mental diseases the dynamic approach must be studied and psychotherapy psychoanalytically directed. My associates and I are doing this at Hillside Hospital and are training our physicians to use this approach.

We do not use electric shock therapy for the psychoneuroses—it is used only for the psychoses. We have seen depressions which have failed to respond to electric shock therapy and which, on further observation, were clarified as neurotic depressions. For this reason, we use only psychotherapy with the psychoneuroses.

Dr. Mosse's subject is extremely interesting; but here, again, it is essential to know exactly what one is talking about. I have heard electric shock therapy discussed empirically by one man and from the psychologic standpoint by another; it is clear that these are two separate and distinct subjects. Dr. Mosse spoke of the relation of electric shock therapy and personality structure, certainly an extremely important topic. It would be wrong to overlook any new therapeutic means or to fail to study such means from every possible point of view. It is of great interest and importance to find out what happens in the psyche of the patient during the time he is undergoing shock treatment. In a paper on the psychologic experiences of patients in shock therapy (*Internat. J. Psycho-Analysis* **21**:179, 1940) I came to conclusions similar to those of Dr. Mosse, namely, that

during shock therapy the patient goes through two phases: First, he regresses to a primitive level of his ego structure, and then he passes through a phase of restoration of the ego. If these conclusions are correct, it is obvious that one must help the patient in the restoration of his ego by the application of psychotherapy.

DR. ISRAEL STRAUSS: We have been hearing tonight of curing the psychoneuroses. Every doctor will admit that very little illness is cured by the physician. A surgeon may remove an appendix, but a physician does not cure chronic endocarditis or chronic nephritis. He helps the patient over his crisis. Likewise, in psychiatry, we do not cure many patients. We may send the patient out of the office or the institution apparently cured, with the reservation on our part that he may have a recurrence, just as a man with mitral insufficiency may have a recurrent failure of his heart, or we send him out as a social recovery, which means that he is capable of carrying on. But complete psychiatric cures are not many.

I should like to say a few words about the general practitioner's relation to the neurotic patient, because, unlike most of the men who have discussed the papers tonight, I have been a general practitioner. The general practitioner can, and will, be of tremendous service in handling abnormal personalities if properly prepared. The young physician's training in the hospital is of even greater aid in his approach to a patient than the teaching he receives in a medical school. But today so much stress is laid on the physical condition of a patient and so little attention is paid to his past history, not only physical but psychologic, that the examination often becomes a purely mechanical one. I have seen instances in the medical wards of a large hospital in which even before the attending physician had seen the patient the intern has asked for every form of chemical examination of the blood, roentgenologic studies, examinations of various parts of the body and a schedule of consultations with various specialists of the hospital—in other words, what he is proud to call a complete work-up—and all these, mind you, before any attempt has been made to use the diagnostic acumen of an experienced physician. The result is that when this young practitioner enters the field of private practice his views are so distorted that he is at a loss in approaching the nervous patient; yet I venture to say that in 75 per cent of his practice he will be dealing with patients in whom, in one form or another, the emotional state is a dominating factor. The general practitioner of the past, who knew the patient from birth, through adolescence, to full maturity, and for years thereafter, had such a grasp of the patient's physical and mental attitude and the environmental influences that he was in a position to exercise all the power of that transference which can exist between patient and physician. I wonder, in this connection, how many of the people on Dr. Denker's list lived outside the cities and how many were urban dwellers. A comparison of the results in these two classes of patients would be extremely interesting in showing what the general practitioner could really do.

DR. ERICH P. MOSSE: No one will blame me if I use my one minute to answer Dr. Kennedy. I remember a brilliant discussion of Dr. Kennedy's before the Academy about a year ago in which he stressed his opinion that the phenomenon of life and its pathologic modifications could be understood only as a psychosomatic whole, and that it was due only to the shortcomings in one's own personality organization that one speaks of an organic and a psychologic approach. Today Dr. Kennedy seems to have regressed to a purely bodily approach. I should not go so far as to call his way of discussion insincere, but I felt, when he talked just now, that he had repudiated in essence what he had said before. In my opinion, a neurosis, like every disease, must be treated from both the organic and the psychologic side. A method like electric shock cannot be applied by simply turning a switch, in the belief that thus one cures the patient. That is nothing but a belief in magic. It is just this magic that we as psychiatrists educate our patients not to believe in.

DR. CLARENCE P. OBERNDORF: I believe that the psychoneurotic patients in Dr. Denker's series represent for the most part the anxiety and depressive types, which

often recover spontaneously in time. From personal experience, I should say that the patient who finally comes to the private psychiatrist is one who has been subjected to many forms of treatment before he seeks psychologic aid and, for this reason perhaps, Dr. Denker's statistics are not entirely comparable.

In my own paper this evening, I said that the element of confidence is important in all forms of psychotherapy, and it is not improbable that this faith exists to a greater extent between the patient and his family physician than may occur at the outset of a psychiatric procedure with a new doctor.

Dr. Denker's report inferentially brings in the element of time, which may also operate in the recoveries reported in other forms of psychotherapy, including psychoanalytic treatment, which is sometimes continued over several years.

DR. JAMES H. WALL: I am disappointed that there is doubt as to the type of psychotherapy which we used. In the first place, we treat the patient. We certainly use the psychobiologic and dynamic approach in conjunction with shock treatment, as is illustrated by one of the cases Dr. Hamilton mentioned.

DR. PETER G. DENKER: I am sorry to have to differ with Dr. Brill in some of his comments. I do not believe the patients I presented can fairly be said to have "mild" neuroses, since, as I specifically stated in the paper, they had been totally unable to carry on with any occupation for at least a three to six month period before disability benefits had even begun; from this point on they were disabled for an additional period of one to five years, and 10 per cent were still disabled after this five year period. It is difficult for me to see how such a series differs fundamentally from the series of psychoneurotic patients reported by the psychoanalytic institutes of Chicago and Berlin; if anything, they represent a more severe type, since many of the patients treated by these institutes were ambulatory and sufficiently well adjusted to carry on with their occupations and social obligations. Dr. Brill commented with reference to electric shock, that he could not be sure whether depressed patients treated by this means would not have recovered in the same time without the electric shock therapy. It seems to me that he should apply a similar critical attitude in the therapy of the neuroses. That was the purpose of this study—to see what results were obtained in the treatment of these psychoneuroses when "deeper" psychotherapy was not used. Unless such "control" studies are made, one cannot be scientifically honest in assessing the therapeutic value of any psychiatric or psychoanalytic procedure. I do not understand why psychoanalysts with the large experience of Dr. Brill, of many years, have not published their results in a comprehensive series of cases, whether the cases represented the mild or the more severe type. It is all very well to talk of the results in 2, 3 or a few cases, but unless the experience in a larger series is compared with a similar series in which other therapeutic means were used the effectiveness of the procedure cannot be evaluated.

I fully agree with Dr. Kubie's comments on the importance of such "controls." It would be interesting if, as he suggests, a study were made of the outcome in cases in which no treatment at all was instituted, either by practitioners or by psychiatrists. This, of course, would be extremely difficult. I cannot, agree, however, with Dr. Kubie as to the element of compensation in these cases. The patients did not get well when the compensation ceased, but continued to receive compensation until they were able to adjust adequately and go back to work. He is putting the cart before the horse; as I mentioned in my paper, the fact of monthly income was a definite deterrent to their progress. The results obtained by the general practitioners in this difficult group are therefore all the more admirable.

As to Dr. Strauss's question, it is true that most of these patients were from small towns all over the United States, and the general practitioners knew them and their families well, so that the element of confidence was already present. In most of these towns there was no psychiatrist; so the general practitioner had to see the patient through his long siege, and on the whole did a most capable job.

PHILADELPHIA PSYCHIATRIC SOCIETY

Samuel B. Hadden, M.D., *President, in the Chair*

Regular Meeting, April 12, 1946

The Problem of Alcoholism. DR. BALDWIN L. KEYES.

The enormity of the problem presented by alcoholism staggers the imagination. The average American spends more than 4 per cent of his income for hard liquor. It has been shown that the cost of care for alcoholism in one year in the United States far exceeds $12,000,000—more than $1,000,000 a month—and exceeds two thirds of the cost of care of all bodily ills.

Recent studies have shown that in a series of 7,000 cases of alcoholism in three institutions in one of the larger cities the results of treatment were largely ineffective.

It is a healthy omen that legal minds have come to recognize that alcoholism is the demonstration of an illness and therefore that corrective measures must be guided toward care and prevention, rather than punishment and incarceration. In the way of prevention, efforts toward prohibition have been made in many centuries, at various times, and have always proved failures.

The consumer of alcohol seeks the cortical depressant action of alcohol and finds its transient effects a great relief to him, since through them he is separated somewhat from the full realities of himself and his situation, his anxieties and his inhibitions, he regresses comfortably for a few moments, and life with his friends becomes a little more tolerable. Many narcotics and hypnotics have a somewhat similar effect and are habit forming for the same reasons, though most of them are too slow acting to satisfy the man accustomed to the quick relief of alcohol.

Most investigators of the causes of alcoholism are agreed that the largest number of cases depend on recognizable weaknesses and deviations of personality, which, however, may often be the result of depending too much on the use of alcohol to relieve periods of acute stress, until eventually a habit is established and the need of the drug becomes increasingly stronger.

Many have stressed that alcoholism is not hereditary but is an acquired form of self expression, often the result of immature craving for attention, an effort to blot out the present and, at times, an unconscious drive toward self destruction.

Treatment of the alcoholic addict would seem to require primarily a recognition of the difficulties in the individual case, for, though there may be many similarities, especially in mechanism, particular problems exist in each case. Primarily, the patient must himself wish to recover from his alcoholism, for unless he holds to this decision firmly he is certain to fail in any measure outlined to help him.

In many cases, however, the patient cannot reach this conclusion without a great deal of patience, tolerance and understanding on the part of those trying to guide him. It may be necessary to render him inaccessible to alcohol for a time in order that he may remain sober long enough to permit a fuller discussion of his problem and helpful suasion to a point at which he will be interested in a deeper investigation of his inner self. With such patients, institutionalization, even protective custody, is at times necessary. Perhaps the conditioned reflex method of treatment will aid many patients to establish control of their alcoholism long enough to permit psychotherapeutic and other measures to get under way.

There can be no one best type of treatment. Some patients will do well through emotional channels, such as religious conversion; others, through reliance on understanding and responsible companionship, such as that established through Alcoholics Anonymous. Practically all patients will require some form of psychotherapy, especially those with deep-seated personality disorders and serious neuroses.

The Conditioned Reflex Treatment of Alcoholism. Dr. Walter L. Voegtlin, Seattle (by invitation).

The treatment of chronic alcoholism by conditioning the patient against alcoholic liquors requires the same scientific approach and the fastidious application of technical details that are necessary in any conditioning experiment. A tendency to lose sight of this important fact has caused certain workers to formulate unscientific, erratic and poorly designed schemes of treatment which, through their very ineffectiveness, may tend to throw discredit on this type of therapy.

A conditioned reflex aversion to liquor is established during the course of five to eight treatment seances. Each seance consists of a conditioning experience, during which the conditioned stimulus (liquor of various kinds) and the unconditioned stimulus (nausea and vomiting after the hypodermic injection of emetine hydrochloride) are impressed on the patient's consciousness in proper sequence. It is of fundamental importance that the exhibition of the conditioned stimulus (liquor) must precede and overlap the exhibition of the unconditioned stimulus (nausea and vomiting). Conditioning procedures are not adapted to use in the home, the office or even a general hospital.

Since the conditioned stimulus is specific in its action, it is necessary to use all possible kinds of liquor during treatment. If this is not done, the patient will acquire an aversion to one or two liquors but not to others.

A high degree of technical skill is requisite in persons administering the treatment seances. It is of particular importance that mature judgment be made the basis of decisions on the following questions: (1) whether the patient is acquiring a true conditioned reflex or merely a distaste for liquor; (2) whether the conditioned reflex is being extinguished as a result of too rapid or too slow progress; (3) whether the progressive seances represent an arithmetical serial potentiation, with each seance more difficult than the preceding one; (4) when the patient has received a maximum conditioned reflex aversion to liquor, and (5) how soon the patient should return for reenforcement.

Over 4,000 patients with chronic alcoholism have been treated by conditioning procedures in the institution with which I am associated during the last ten years. The last comprehensive survey made before the war presented the results of treatment of 1,526 patients and showed that 51.5 per cent had remained totally abstinent for four years or longer after the completion of treatment.

DISCUSSION

Dr. Samuel B. Hadden: When Dr. Voegtlin is beginning the conditioned reflex treatment, does he inform the patient of the nature of the injection? Is the patient told of the mechanism of production of the conditioned reflex? I should like to know, also, whether such simple things as a cold in the head may disturb the conditioning of the receptor organs?

Dr. C. Nelson Davis: Since alcoholism is a disease in itself, many of the patients have persistent vomiting and inability to eat. They may go through a horrible spell because of the vomiting. Nevertheless, having had this experience, they immediately return to drinking. In what way does the conditioned reflex counteract the natural effects of the disease, that is, the vomiting?

Dr. O. Spurgeon English: Were any relapses represented in the 51 per cent figure cited? What is the program which Dr. Voegtlin and his associates follow in helping the patient make the necessary emotional readjustments after giving up drinking?

Dr. Walter L. Voegtlin, Seattle: In reply to Dr. Hadden's question whether we tell the patient what is going on: Formerly we did not. We kept it a secret from him, in the belief that if he knew what we were doing he would not be much impressed with the treatment. In a recent symposium on alcoholism sponsored

by the Yale school, published in the September 1944 issue of the *Quarterly Journal of Studies on Alcohol,* page 212, Dr. A. J. Carlson took us severely to task for being so dishonest as to lie to the patient. His point is probably well taken. It really does not matter whether the patient knows that he is being conditioned. Conditioning will go on whether or not the patient knows that he is being conditioned, and the eliciting of a conditioned reflex is just as incapable of being controlled by the patient's will power as is the eliciting of an unconditioned reflex. We therefore now tell our patients that we are conditioning them. This has the advantage, as you probably noticed in the picture, that the patient is not anxious to drink after he has become ill from the emetine. Yet if he does not drink he cannot be conditioned. He can be told, therefore, that it is necessary for him to cooperate and that he must drink in spite of his not wanting to. I think our results have been better since we started to be honest with the patient.

Infections of the upper respiratory tract are of fundamental importance in conditioning as a whole. Of course, the presence of mucus in the nose, which would prevent the patient from smelling the liquor, would take away a valuable aspect of conditioning, i. e., the olfactory aspect. In that way it is important. It is important also to avoid any extraneous stimulus while the patient is being conditioned. It is for this reason that we have constructed a special treatment room which is soundproof and which has nothing in it of any particular interest to the patient. Discomfort accompanying any infection tends to take the patient's mind off the fact that he is drinking liquor and that he is being made very ill as a result. A full bladder, a need to move the bowels, an uncomfortable position or a headache—all these are negative stimuli which detract from the effectiveness of the conditioning procedure.

The question why the patient does not acquire a conditioned reflex as a result of becoming sick when he drinks is an interesting one, and the answer is equally interesting. Those who worked with conditioning procedures found very early, and Pavlov made a great deal of this fact, that one cannot condition an anesthetized or a narcotized or an alcoholized experimental animal. The same thing holds true, of course, with the human subject. Simply stated, the patient may be very ill on Saturday night, when he is drinking, but on Sunday morning, when he awakens, he does not remember much about how ill he was; and as a result he does not acquire a conditioned reflex aversion to liquor. This fact is of importance also, I believe, in the attempt to condition with apomorphine as the conditioned stimulus. One is then using a stimulus that narcotizes as soon as it is injected.

In reply to Dr. English, the data as he heard them are correct. We have at present a series of over 4,000 patients who have been treated with this method, although we do not have a statistical analysis of the entire group. The war prevented us from making any recent survey. However, that is being done at the moment, and we expect soon to publish our results. The last survey that we made included over 1,500 patients and was reported by Dr. Frederick Lemere and associates (The Conditioned Reflex Treatment of Chronic Alcoholism, *J. A. M. A.* **120**:269 [Sept. 26] 1942). Fifty-one per cent of the patients who had been treated four years or more before the time of the survey were not drinking; i. e., they were entirely abstinent.

The present survey indicates that our later results will not differ greatly from those reported in the series of 1,500 patients. We have definite indications, although the figures are not accurate at this time, that of our patients who were treated ten years ago or longer at least 40 per cent have remained abstemious up to the present. I should like to emphasize that these data relate only to the results of the first treatment. If a patient was treated and began to drink again, and was treated a second time successfully, he was nevertheless counted for statistical purposes as having relapsed. I believe therefore that if we could add to the original successes the successes that result from a second treatment, or possibly even a third treatment, our results might be even a little better than those reported.

The other question that Dr. English has raised is one to which I always get two different and distinct reactions when I present this material. The internists

as a rule are impressed by what they consider a horrible waste of good liquor, whereas usually one or two psychiatrists, particularly those who are accustomed to think in terms of cause and effect, ask whether this method is a logical and a reasonable treatment for alcoholism, for the reason that, as Dr. English pointed out, one takes away the patient's escape mechanism, so to speak, without doing anything constructive about his psychiatric difficulties.

I think this point was also brought out by Dr. Keyes. I am not a psychiatrist, and possibly some may think me presumptuous for even having an opinion on these things; but I believe I have had enough experience with a fairly large number of alcoholic persons to entitle me to an opinion at least. The point brought out by Dr. Keyes, that alcoholic patients are not all of one type, is probably the crux of the matter. Certainly, there is a primary type of alcoholic patient, who drinks as a symptom of an underlying psychiatric difficulty. On the other hand, at least on the West Coast, the great majority of patients are not of that type. They are the persons with so-called secondary alcoholism, which Dr. Keyes mentioned, and have acquired their abnormal and excessive drinking gradually over a period of years as a result of habituation. It has never been proved, I believe, that all alcoholic persons drink because they have psychiatric troubles. I am inclined to think that this idea is one of those things connected with alcoholism which one assumes to be true without having made any scientific analysis. It is possible that some of the new mechanistic methods of assaying personality may yield a pattern into which alcoholic persons may fit, but I doubt it. I believe, therefore, that not all alcoholic persons have to make a readjustment, i. e., a profound readjustment, any more than does the mildly psychoneurotic drinking person. On the other hand, I believe that the patients who drink as a symptom of profound psychiatric imbalance will be mainly benefited by conditioning in that it keeps them sober for a while, so that they are accessible to psychotherapy. I do not believe that conditioning alone would ever cure these patients. In our experience, such patients account for less than 20 per cent of the total number of alcoholic patients.

Suppose, however, that all alcoholic patients have psychiatric difficulties, and that conditioning does nothing to smooth out their psychiatric problems; it does, nevertheless, give the patient an opportunity to remain sober in his normal environment and to readjust spontaneously. Some authors have asserted that patients who have been conditioned do not readjust. I question that statement, for I am certain that no one has ever examined a group of patients who have been treated by conditioning measures to see whether or not they do readjust. In our experience, the patient who stops drinking readjusts very well in his sober life, much better, in fact, than he did in his drinking life. I think, therefore, that it is entirely possible for these patients to readjust spontaneously. The fact that no outside hand is guiding this readjustment should not detract from its value.

Alcoholics Anonymous. DR. C. NELSON DAVIS.

I have observed the work of Alcoholics Anonymous for the past six years. It has been a stimulating and valuable experience. This organization cannot help all alcoholic persons, but it is important to recognize that its members can and do help some.

The question is frequently posed, "How does it work?" I do not know, nor have I heard a satisfactory explanation. There is no pattern, no common denominator, either in the treatment or among the victims of the disease, who represent a cross section of society.

This organization uses in its therapy a composite of many fundamental principles of medicine, psychiatry and religion. I shall mention in outline some mechanisms of the therapy which the members of Alcoholics Anonymous apply.

1. Acceptance of alcoholism as a disease. They accept alcoholism as a disease, without moral stigma, and realize that it can be arrested but never cured. The alcoholic person, they warn, is at all times just one drink removed from his disease.

2. Friendship. Alcoholics Anonymous provides the victim of alcoholism with an entering wedge to an acceptable social level of companionship and friendship. He is no longer an outcast when he enters its membership. He learns to live his life on a twenty-four hour basis, without fear of the future.

3. Personal contact. The individual member of Alcoholics Anonymous reaches out to help a fellow alcoholic addict who sincerely desires to stop drinking, thus utilizing the strong bond which exists among persons with this addiction.

4. Group therapy in open meetings. Testimony, confession and a crystal clear challenge invite the victim of the disease to understand his condition and show him a way to do something about it.

5. Individual psychotherapy in closed meetings. These gatherings, directed by one or more "dry" alcoholic habitués, utilize spiritual power freed from the restrictions of organized religion, urging the acceptance of God (or a "higher power") and leaving the individual to form his own conception of that God or power.

6. Stimulation of the ego. A member of Alcoholics Anonymous knows that he is some one, not just a "drunk." He sees men and women who had reached the lowest rung of the social ladder once again enjoying a life of confidence, socially acceptable and established successfully in their vocations. He is spurred to emulate them.

Alcoholics Anonymous combines in practice accepted fundamentals of medicine and religion, in an effort to help fellow alcoholic addicts who are sincerely desirous of attaining sobriety. This amalgam of many forms of therapy, as blended in the program of the organization, has enabled many alcoholic persons to achieve and maintain sobriety for periods of as long as six years.

A presentation of personal experiences was made by 3 members of the original group of Alcoholics Anonymous of Philadelphia. These members gave convincing and graphic accounts of their experiences in recovery achieved in connection with their associations in Alcoholics Anonymous. In its simplest form, the therapeutic situation includes (*a*) admission of alcoholism; (*b*) personality analysis and catharsis; (*c*) adjustment of personal relations; (*d*) dependence on some higher power, and (*e*) working with other alcoholic patients.

DISCUSSION

DR. C. NELSON DAVIS: There is nothing general or specific that one can say about this organization. There is nothing specific that they do, and there is nothing specific that one can find out about the people who attend the meetings. They represent a cross section of society. I shall call attention to some of the many factors that are at work in bringing some of these men to sobriety.

In the early days, these men who came down to St. Luke's and Children's Medical Center were desperately hurt. They had lost their homes and their jobs; they were outcasts from their families and from society. They came from the House of Correction. They came from at least sixteen institutions for the treatment of mental disease and had been in the best and in the worst jails.

First, Alcoholics Anonymous introduces to the individual victim the concept that he is not responsible for his actions but that he is suffering from a disease, that he need not approach the problem as one with a stigma but that he can return to society as he would if he had been hospitalized for pneumonia.

Second, the approach of Alcoholics Anonymous is a means of education. It is an agent for spreading to the family the facts that are known about alcohol. The members have their clubhouse. When the alcoholic addict reaches the bottom rung of the ladder, he has no place to go. He is antisocial, and society does not want him. He is unemployable. The clubhouse gives him a society to enter, and the clubhouse is willing to accept him and carry him through the early days of sobriety and through the days of the "dry jitters." The organization does what medicine cannot do, although it follows a fundamental rule of medicine. It treats the whole man. All that medicine does is to treat the disease and produce sobriety

in the man, but Alcoholics Anonymous has a twenty-four hour program. He has a clubhouse to go to, and he has a number of friends whom he can contact immediately if he has the impulse to drink. The association is so set up that he can phone some one who will come and sit with him or who will carry him over the period during which he has the desire to drink.

The previous speakers have mentioned the spiritual side. There is no doubt that it does play an important part. Alcoholics Anonymous has helped a great many men There are since the first year or two 41 members who have remained dry; that is a much better record than I have attained, for my results have been indifferent The alcoholic addict hurts many people—his father, his mother, his sister, his brother, his employer. He even hurts the physician, for of all the patients the doctor treats the alcoholic is probably the most contemptible, and the one who will not follow advice. Frequently, the alcoholic patient comes to the doctor because he is literally dragged to him, and of course that places the physician at a disadvantage. These men, because of the educational program of Alcoholics Anonymous, seek the organization, and in seeking it they are in a better position to receive what it has to offer. Several years ago Dr. Hadden and I started group therapy at the Presbyterian Hospital. Group therapy is a mechanism which is generally used in the open meetings of the association. The individual members repeat their experiences in somewhat testimonial fashion and state how the organization has helped them. They also have closed meetings, and in the closed meetings they are not far removed from the direct application of psychotherapy.

Therefore, this organization applies many formulas well known to medicine. Not only does it have many points at which to attack the problem, but it does so on a twenty-four hour basis. If it can bring some people to sobriety and make their families and friends happy, it is doing a worth while work.

Book Reviews

L'électro-choc et la psycho-physiologie. By Jean Delay. Price, 230 francs. Pp. 169. Paris: Masson & Cie, 1946.

It is a keen intellectual pleasure to settle down with this volume by a master of French prose. The author, recently visiting this country, has succeeded Henri Claude at Asile Ste. Anne and the Faculté de Medicine and has seven previous monographs to his credit in the past eleven years. That is quite a record, considering that half this time his country was at war and that his teaching was done in difficult circumstances during the occupation of Paris. In this particular volume he attempts to bring some order into the confused theories concerning the mechanism of electroshock.

Electroshock has its principal effects on mood (*humeur*) and on consciousness (*conscience*). "Mood is that fundamental affective toning, rich with all the emotional and instinctual drives, which gives an agreeable or disagreeable flavor to one's state of mind, swinging back and forth between the two extremes of joy and sorrow." Consciousness, the author avers, is "a biologic function, a state of vigilance." As such, it is subject to perturbations running all the way from crystal clear consciousness, through momentary absences and natural sleep, to pathologic sleep, hypnoidal states, confusion, delirium, stupor and coma.

In his study of the effects of passage of the electric current through the brain, the author differentiates five crises of varying durations. These pertain to consciousness, which is lost immediately; to the convulsion, which sets in after a slight delay but is soon over; to the neurovegetative manifestations; to the humoral alterations, and, finally, to the bioelectric changes, which may last for days or weeks after the completion of the course of electroshock. The number of cases studied for such deviations is rather small, and the author relies on prewar physiology for his data, so that his conclusions are broad rather than deep. He emphasizes the importance of the hypothalamus in the alterations in mood that occur as the result of this type of treatment.

There is a great deal of space given to the experimental and neurosurgical observations in relation to the hypothalamus up to 1940. The author stresses particularly the alterations in mood that occur in response to manipulation of the hypothalamus. These experiments, he believes, have an important bearing on the whole question of the psychoses and neuroses. He would assign to the hypothalamus the role of the awakener of consciousness, the cerebral center of affect, *"le noeud de l'élan vital."* While remarking on the functions of the cerebral cortex in bringing the individual into relation with his surroundings, the author stresses the importance of the hypothalamus as the driving power under which the cortex organizes itself for proper function. "Electroshock recalls consciousness to its logic function of vigilance by a process of reintegration inverse to .that of dissolution, with both positive and negative aspects, the restoration of mental syntheses and the abolition of oneiric emancipations."

In the chapters devoted to the discussion of mood, the author is rather schematic. He divides functional psychoses into the hyperthymic (manic and depressive states) and the hypothymic (hebephrenic), the latter of which may reveal schizoid, paranoid, catatonic or other manifestations. Electroshock stabilizes the mood disorders, the depressed much more easily than the excited phases, while it has limited effect on the hypothymic states, although bringing about a harmoniously functioning affective state in a certain percentage of cases. He points out that affective disorders are usually accompanied with disturbances in the various appetites for food, drink, sleep and sex, all of which are also influenced by gross lesions of the hypothalamus. He admits that no significant structural alterations are to be seen in

the hypothalamus in either affective or hebephrenic disorders, but, nevertheless, finds abundant reason for incriminating this area. Furthermore, he marshals the evidence in favor of the theory that the convulsion itself is a manifestation of hypothalamic perturbation.

Delay's monograph makes pleasant reading and contains a few new ideas; for instance, that neural pathways are "open" only when their chronaxias correspond, and that the regulation of chronaxia depends on the basal regions of the brain. At the same time, the book gives the impression of being hastily written, with too many repetitions. Looked at as an essay in synthesis, and as part of the development of a capable teacher and investigator, it gives promise of even better essays in times to come.

Diseases of the Nervous System. By F. M. R. Walshe. Price, $4.50. Pp. 350. Baltimore: Williams & Wilkins Company, 1945.

This relatively small volume, written for students and general practitioners, serves the purpose admirably. The author makes the following points in describing his purpose: (1) to deal only with what is possible in general practice in the matter of diagnosis; (2) to omit all specialized syndromes and terminology not well known, and (3) to give special emphasis to the life history of any illness, so that one may understand that a nervous disease is a sequence of events rather than the mere localization of a lesion.

The book is written in two sections. The first deals with generalizations in neurologic diagnosis, with a discussion of the anatomy and physiology necessary to make general diagnoses. All controversial theories are omitted. A successful attempt is made to explain the results of various lesions in a simple manner on the basis of physiologic principles. The chapter on factors in diagnosis is broken down into functional subdivisions. The second section deals with the more common diseases of the nervous system. Here, again, they are treated systematically and briefly; differential diagnosis and treatment are both indicated.

A chapter on the general treatment of nervous diseases presents the view that, although many diseases of the nervous system are chronic and not amenable to cure, they need and merit the benefits of physical therapy in order to relieve stiffness and pain and for psychic advantages, since so many of the patients live a long time. Common sense advice is given on the general management of patients, and an evaluation of what is to be expected and what not expected from the various modalities is presented.

A good short chapter on the psychoneuroses is presented in general terms, with considerable attention to the psychosomatic disorders—dynamics are not discussed, and the point is made, perhaps with unwarranted optimism, that most of the psychoneuroses, if correctly diagnosed by the general practitioner, can be adequately handled by superficial therapy. The author correctly emphasizes early correct diagnosis and the importance of not giving the patient a physical diagnosis on which to fixate. The importance of a careful history is reemphasized, and the traumatic effects of "there is nothing the matter" are discussed.

Finally, a simple, systematic outline for the examination of the nervous system is presented.

This book should prove a valuable addition to the library of the practitioner and a practical aid in his ability to understand, diagnose and treat the more common diseases of the nervous system. It should help remove the feeling of helplessness usual in all but the highly trained neurologist.